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Articles

TamTam Instruments

Keyboard instrument


The piano, a common keyboard instrument

A **keyboard instrument** is any musical instrument played using a musical keyboard. The most common of these is the piano. Other widely used keyboard instruments include organs of various types as well as other mechanical, electromechanical and electronic instruments. In common language, it is mostly used to refer to keyboard-style synthesizers.

History

Among the very earliest keyboard instruments are the pipe organ, hurdy gurdy, clavichord and harpsichord. The organ is without doubt the oldest of these, appearing in the 3rd century BC, though this early instrument—called hydraulis—did not use a keyboard in the modern sense. From its invention until the 14th century, the organ remained the only keyboard instrument. Often, the organ did not feature a keyboard at all, rather buttons or large levers which were operated by a whole hand. Almost every keyboard until the 15th century had naturals to each octave.

The clavichord and the harpsichord appeared during the 14th century, the clavichord probably being the earlier. The harpsichord and the clavichord were both very common until the widespread adoption of the piano in the 18th century, after which their popularity decreased. The piano was revolutionary because a pianist could vary the volume (or dynamics) of the sound by varying the vigor with which each key was struck. The piano's full name is "gravicèmbalo con piano e forte" meaning "harpsichord with soft and loud" but can be shortened to "piano-forte", which means "soft-loud" in Italian.

Keyboard instruments were further developed in the early 20th century. Early electromechanical instruments, such as the Ondes Martenot, appeared early in the century. This was a very important contribution to the keyboard's history. There is a now a saying "If you can play piano, you can play anything!".

Construction

The keys were traditionally made of natural materials. The white tangents were made of ivory, the black of ebony, but now artificial materials like plastic are used to cover the wooden keys. Cheaper materials like oak, walnut and soft wood are used now.

On most keyboard instruments, a "black note" is one of the smaller keys that stand above the "white notes". All the black notes found within an octave form a pentatonic scale.[1] Black notes can be referred to as sharps of the white note below, or as flats of the white note above. In keyboard percussion instruments with a layout similar to that of the piano, the corresponding notes are often also called "the black notes" though in reality the bars producing those notes are of the same color as the rest of the instrument's bars.

These notes act as the "accidentals" to the original notes, allowing the player to play sharps or flats of a given note. However, not all notes have a sharp or flat version, and the sharp of one can be the same note as the flat for another, for example C# and Db are the same note.[2]

The five accidentals written as sharps are: C#, D#, F#, G# and A#.

Modern keyboards

Much effort has gone into finding an instrument which sounds like the piano but lacks its size and weight. The electric piano and electronic piano were early efforts that, while being useful instruments in their own right, were not successful in convincingly reproducing the timbre of the piano. Electric and electronic organs were developed during the same period.

Significant development of the synthesizer occurred in the 1960s and has continued ever since. The most notable early synthesizer is the Moog synthesizer, which used analog circuitry. In time, digital synthesis, using actual piano samples, has become common.

List of keyboard instruments

Chordophones

- Clavichord
- Electric piano
  - Clavinet
  - Pianet
  - Rhodes piano
  - Wurlitzer electric piano
- Harpsichord
  - Spinet
  - Virginal
  - Lautenwerck
  - Archicembalo
- Piano
  - Fortepiano
  - Tangent piano
- Bowed clavier
- Hurdy gurdy
  - Keyed fiddle

Aerophones

- Accordion
- Harmonium/Reed organ
- Melodeon
- Melodica
- Pipe organ
- Regal

Idiophones

- Carillon
- Celesta
- Glasschord
- Dulcitone
- Toy piano

Electrophones

- Digital piano
- Electronic keyboard
- Electronic organ
- Electronic piano
- Keytar
- Mellotron
- Optigan
- Synthesizer

References

[1] http://www.learn-piano.org/notes-on-piano.html
[2] http://piano.about.com/od/lessons/a/L1_notes.htm

External links

- The general keyboard in the age of MIDI (http://www.bikexprt.com/music/bosanqet.htm)
- Renaissance Keyboards (http://www.metmuseum.org/toah/hd/renk/hd_renk.htm) on the Heilbrunn Timeline of Art History, The Metropolitan Museum of Art
- The Pianofortes of Bartolomeo Cristofori (http://www.metmuseum.org/toah/hd/cris/hd_cris.htm) on the Heilbrunn Timeline of Art History, The Metropolitan Museum of Art

Percussion instrument

A **percussion instrument** is any object which produces a sound when hit with an implement, shaken, rubbed, scraped, or by any other action which sets the object into vibration. The term usually applies to an object used in a rhythmic context or with musical intent.

The word "percussion" has evolved from Latin terms: "percussio" (which translates as "to beat, strike" in the musical sense, rather than the violent action), and "percussus" (which is a noun meaning "a beating"). As a noun in contemporary English it is described in Wiktionary as "the collision of two bodies to produce a sound". The usage of the term is not unique to music but has application in medicine and weaponry, as in percussion cap, but all known and common uses of the word, "percussion", appear to share a similar lineage beginning with the original Latin: "percussus". In a musical context then, the term "percussion instruments" may have been coined originally to describe a family of instruments including drums, rattles, metal plates, or wooden blocks which musicians would beat or strike (as in a collision) to produce sound.

Percussion beaters and sticks

History

Anthropologists and historians often speculate that percussion instruments were the first musical devices ever created. The human voice was probably the first musical instrument, but percussion instruments such as hands and feet, then sticks and rocks, were in widespread use long before recorded musical history.

Percussive surface in a resonant cavity. A cave painting of human hands surrounded by red markings — early percussion instrument

Function

Percussion instruments may play not only rhythm, but also melody and harmony.

Percussion is commonly referred to as "the backbone" or "the heartbeat" of a musical ensemble, often working in close collaboration with bass instruments, when present. In jazz and other popular music ensembles, the bassist and the drummer are often referred to as the rhythm section. Most classical pieces written for full orchestra since the time of Haydn and Mozart are orchestrated to place emphasis on the strings, woodwinds, and brass. However, often at least one pair of timpani is included, though they rarely play continuously. Rather, they serve to provide additional accents when needed. In the 18th and 19th centuries, other percussion instruments (like the triangle or cymbals) have been used, again relatively sparingly in general. The use of percussion instruments became more frequent in the 20th century classical music.

In almost every style of music, percussion plays a pivotal role. In military marching bands and pipes and drums, it is the beat of the bass drum that keeps the soldiers in step and at a regular speed, and it is the snare that provides that crisp, decisive air to the tune of a regiment. In classic jazz, one almost immediately thinks of the distinctive rhythm of the hi-hats or the ride cymbal when the word "swing" is spoken. In more recent popular music culture, it is almost impossible to name three or four rock, hip-hop, rap, funk or even soul charts or songs that do not have some sort of percussive beat keeping the tune in time.

Because of the diversity of percussive instruments, it is not uncommon to find large musical ensembles composed entirely of percussion. Rhythm, melody, and harmony are all represented in these ensembles.

Percussion notation

Music for pitched percussion instruments can be notated on a staff with the same treble and bass clefs used by many non-percussive instruments. Music for percussive instruments without a definite pitch can be notated with a specialist rhythm or percussion-clef; More often a treble clef (or sometimes a bass clef) is substituted for rhythm clef.

Classifications

Percussion instruments are classified by various criteria sometimes depending on their construction, ethnic origin, function within musical theory and orchestration, or their relative prevalence in common knowledge.

Percussion instruments are sometimes classified as "pitched" or "unpitched." While valid, this classification is widely seen as inadequate. Rather, it may be more informative to describe percussion instruments in regards to one or more of the following four paradigms:

By methods of sound production

Many texts, including *Teaching Percussion* by Gary Cook of the University of Arizona, begin by studying the physical characteristics of instruments and the methods by which they can produce sound. This is perhaps the most scientifically pleasing assignment of nomenclature whereas the other paradigms are more dependent on historical or social circumstances. Based on observation and experimentation, one can determine how an instrument produces sound and then assign the instrument to one of the following four categories:

Idiophone

"Idiophones produce sounds through the vibration of their entire body."[1] Examples of idiophones:

- Bock-a-da-bock
- Cabasa
- Cajón
- Celesta
- Chimes
- Cowbell
- Crash cymbals
- Crotales
- Güiro
- Handbells
- Hi-hat
- Lummi stick
- Marimba
- Orchestra bells
- Singing bowls
- Slit drum
- Suspended cymbal
- Triangle
- Vibraphone
- Vibraslap
- Wood block
- Xylophone

Membranophone

Most objects commonly known as "drums" are membranophones. "Membranophones produce sound when the membrane or head is struck."[1]

Examples of membranophones:

- Bass drum
- Bongos
- Conga
- Darbuka
- Djembe
- Mridangam
- Octoban
- Snare drum
- Tabla
- Timpani

- Tom-tom
- The lion's roar and the cuíca are friction instruments which are not struck like other drums, but the sound is produced by applying friction to a string (lion's roar) or to a stick (cuíca) that is attached to the center of the membrane. In both cases, it is the membrane that vibrates, not the string nor the the stick, thus ensuring their classification as membranophones. In the case of the lion's roar, a resined string (or gut) is fastened through a hole in the membrane. In the case of the cuíca, the stick is attached (tied) to the membrane before it is stretched and tightened to the body of the instrument, and the stick is accessible by placing one hand inside the body, rubbed with a wet cloth.
- Wind machines: A wind machine in this context is not a wind tunnel and therefore not an aerophone. Instead, it is an apparatus (often used in theatre as a sound effect) in which a sheet of canvas (a membrane) is rubbed against a screen or resonator; this action produces a sound which resembles the blowing of wind.

Chordophone

Most instruments known as "chordophones" are defined as string instruments, but some such as these examples are percussion instruments also.

- Hammered dulcimer, Cimbalom
- Onavillu

Aerophone

Most instruments known as "aerophones" are defined as wind instruments such as a saxophone whereby sound is produced by a person or thing blowing air through the object. Examples of aerophones played by percussionists:

- Apito or samba whistle
- Siren
- Slide whistle
- Whistle or police whistle

By musical function or orchestration

When classifying instruments by function it is useful to note if a percussion instrument makes a definite pitch or indefinite pitch.

For example, some percussion instruments (such as the marimba and timpani) produce an obvious fundamental pitch and can therefore play melody and serve harmonic functions in music. Other instruments (such as crash cymbals and snare drums) produce sounds with such complex overtones and a wide range of prominent frequencies that no pitch is discernible.

Definite pitch

Percussion instruments in this group are sometimes referred to as "pitched" or "tuned".

Examples of percussion instruments with definite pitch:

- Anvil
- Caisadrum
- Chimes/Tubular bells
- Crotales
- Glass harmonica
- Glass harp
- Glockenspiel
- Handbells
- Hang

- Marimba
- Mridangam
- Steelpan
- Tabla
- Timpani
- Tuned Triangle
- Vibraphone
- Wind chimes
- Xylophone
- Xylo-marimba

Indefinite pitch

Instruments in this group are sometimes referred to as "non-pitched", "unpitched", or "untuned". This phenomenon occurs when the resultant sound of the instrument contains complex frequencies through which no discernible pitch can be heard.

Examples of percussion instruments with indefinite pitch:

- Bass drum
- Castanets
- Cymbals
- Rainstick
- Slapstick or whip
- Snare drum
- Tamtam
- Tom-tom

By prevalence in common knowledge

Although it is difficult to define what is "common knowledge", there are instruments in use by percussionists and composers in contemporary music which are certainly not considered by most to be musical instruments of any kind. Therefore, it is worthwhile to *try* to make distinction between instruments based on their acceptance or consideration by a general audience.

For example, it is safe to argue that most people would not consider an anvil, a brake drum (the circular hub which houses the brake on the wheel of a motor vehicle), or a fifty-five gallon oil barrel to be musical instruments, yet these objects are used regularly by composers and percussionists of modern music.

One might assign various percussion instruments to one of the following categories:

Conventional or popular

- Drum kit
- Gong
- Tambourine

Unconventional

(Sometimes referred to as "found" instruments)

- Automobile Brake Drum
- Beer kegs
- Brooms
- Clay pots

- Five gallon buckets
- Garbage cans
- Metal pipes
- Metal pots
- Plastic bag
- Rocks in a bucket
- Shopping carts
- Spokes on a bicycle wheel

John Cage, Harry Partch, Edgard Varèse, and Peter Schickele, all noted composers, created entire pieces of music using unconventional instruments. Beginning in the early 20th century, perhaps with *Ionisation* by Edgard Varèse which used air-raid sirens (among other things), composers began to require percussionists to invent or "find" objects to produce the desired sounds and textures. Another example includes the use of a hammer and saw in Penderecki's *De Natura Sonoris No. 2*. By late 20th century, such instruments had become common in modern percussion ensemble music and popular productions, such as the off-Broadway show, Stomp. Rock band Aerosmith used a number of unconventional instruments in their song Sweet Emotion, including shotguns, brooms, and a sugar bag.

By cultural significance or tradition

It is not uncommon to discuss percussion instruments in relation to their cultural origin. This has led to a division between instruments which are considered "common" or "modern," and folk instruments which have a significant history or purpose within a geographic region or cultural group.

Folk percussion instruments


Some percussion instruments

- Berimbau
- Bodhrán
- Bombo legüero
- Cajon
- Dhaa
- Dhime
- Dhol
- Dholak
- Djembe
- Gamelan
- Kalimba (Thumb Piano)
- Kheen
- Kpanlogo
- Lagerphone
- Latin percussion
- Madal
- Marimba
- Marimbula
- Naykheen
- Pogo cello
- Skrabalai
- Steelpan
- Taiko
- Tambourine
- Thavil

- Timbales

Ancient Chinese musical bronze bells from the Eastern Zhou Dynasty, c. 6th century BC.

- Tonbak
- Urumee
- Udukai

"Common" drums

This category includes instruments which are widely available and popular throughout the world:

- Drum kit, typically consisting of:
  - Bass drum
  - Crash cymbal
  - Floor tom
  - Hi-Hat cymbals
  - Snare drum
  - Tom-tom drums
- Marching percussion instruments
- Orchestral percussion instruments

Names for percussionists

The general term for a musician who plays percussion instruments is "percussionist" but the terms listed below are often used to describe a person's specialties:

- Balafonist: a balafon player
- **Bombisto**: a bombo legüero player
- Bongocerro: someone who plays bongos and usually cencerro (a cow bell)
- **Congalero**, conguero: someone who plays congas
- **Cymbalist**: someone who plays cymbals
- Drummer: a term usually used to describe someone who plays the drumset, hand drums or a single drum such as Snare drum.
- **Glockenspielist**: someone who plays the glockenspiel.
- **Güirero**: someone who plays the güira, a Dominican scraper used in merengue music
- Marimbist: a marimba player
- **Panman**, pannist: a steelpan player
- Timbalero, **timbero**: someone who plays timbales
- Timpanist: a timpani player
- Vibraphonist: a vibraphone player

- Xylophonist: a xylophone player

Notes and references

[1] Gary D. Cook, *Teaching Percussion*, p.2, 3rd edn, 2006, Thomson Schirmer, ISBN 0 534 50990 8

Further reading

- James Blades, *Percussion Instruments and Their History*, (1970).
- Shen, Sinyan, Acoustics of Ancient Chinese Bells, Scientific American, 256, 94 (1987).
- Schick, Steven (May 2006). *The Percussionist's Art - Same Bed, Different Dreams* (http://www.urpress.com/store/viewItem.asp?idProduct=10918). University of Rochester Press. ISBN 9781580462143.

External links

- Percussion instruments (http://www.dmoz.org/Arts/Music/Instruments/Percussion/) at the Open Directory Project
- Drummer Brasil (http://www.drummer.com.br/) — Website for drummers and percussionists
- Video clips of percussion instruments demonstrated (http://www.agababa.net/instruments/instruments.asp)
- Drum Museum, Information about antique hand drums from Africa, New Guinea and the Himalayas (http://www.drummuseum.com/)

String instrument

A **string instrument** (or **stringed instrument**) is a musical instrument that produces sound by means of vibrating strings. In the Hornbostel-Sachs scheme of musical instrument classification, used in organology, they are called chordophones. The most common string instruments in the string family are guitar, electric bass, violin, viola, cello, double bass, banjo, mandolin, ukulele, and harp.

Types of instruments

Construction

String instruments can be divided in three groups.

1. Lutes - instruments in which the strings are supported by a neck and a bout ("gourd"), for instance a guitar, a violin, a saz.
2. Harps - instruments in which the strings are contained within a frame.
3. Zithers - instruments with the strings mounted on a body, such as a guqin, a cimbalom, an autoharp, or a piano.

It is also possible to divide the instruments in groups focused on how the instrument is played.

Types of playing techniques

For a full list, see List of string instruments.

All string instruments produce sound from one or more vibrating strings, transferred to the air by the body of the instrument (or by a pickup in the case of electronically amplified instruments). They are usually categorized by the technique used to make the strings vibrate (or by the primary technique, in the case of instruments where more than one may apply.) The three most common techniques are plucking, bowing and striking.


The double bass is either plucked (pizzicato) or bowed (arco) depending on the genre and piece.

Plucking

Plucking is used as the sole method of playing on instruments such as the banjo, guitar, harp, lute, mandolin, oud, sitar, and either by a finger or thumb, or by some type of plectrum. This category includes the keyboard instrument the harpsichord, which formerly used feather quills (now plastic plectra) to pluck the strings.

Instruments normally played by bowing (see below) may also be plucked, a technique referred to by the Italian term *pizzicato*.

Bowing

Bowing (*Italian: Arco*) is a method used in some string instruments, including the violin, viola, cello, and the double bass (of the violin family) and the old viol family. The bow consists of a stick with many hairs stretched between its ends. Bowing the instrument's string causes a stick-slip phenomenon to occur, which makes the string vibrate.

Ancestors of the modern bowed string instruments are the rebab of the Islamic Empires, the Persian kamanche and the Byzantine lira. Other bowed instruments are the rebec, hardingfele, nyckelharpa, kokyū, erhu, igil, sarangi and K'ni. The hurdy gurdy is bowed by a wheel.

Rarely, the guitar can be played with a bow (rather than plucked) for unique effects.

Striking

The third common method of sound production in stringed instruments is to strike the string.

Violin family string instrument players are occasionally instructed to strike the string with the side of the bow, a technique called *col legno*. This yields a percussive sound along with the pitch of the note. A well-known use of *col legno* for orchestral strings is the Gustav Holst's "Mars" movement from *The Planets* suite.

Other methods

The aeolian harp employs a very unusual method of sound production: the strings are excited by the movement of the air.

Some instruments that have strings have attached keyboards that the player uses instead of directly manipulating the strings. These include the piano, the clavichord, and the harpsichord.

With these keyboard instruments too, the strings are occasionally plucked or bowed by hand. Composers such as Henry Cowell wrote music which asks for the player to reach inside the piano and pluck the strings directly, or to "bow" them with bow hair wrapped around the strings, or play them by rolling the bell of a brass instrument such as a trombone on the array of strings.

Other keyed string instruments, small enough for a strolling musician to play, include the plucked autoharp, the bowed nyckelharpa, and the hurdy gurdy, which is played by cranking a rosined wheel.

Steel-stringed instruments (such as the guitar, bass, violin, etc.) can be played using a magnetic field. An E-Bow is small hand-held battery-powered device which can be used to excite the strings of an electric guitar. It provides a sustained, singing tone on the string which is magnetically vibrated.

3rd Bridge is a plucking method where the string is divided in two pieces and struck at the side which is unamplified. The technique is mainly used on electric instruments, because these have a pickup that amplifies only the local string vibration. It's possible on acoustic instruments as well, but lesser convenient. For instance press on the 7th fret on a guitar and pluck it at the head side and a tone will resonate at the opposed part. At electric instruments this technique can generate multitone sounds remniscent of a clock or a bell.

Changing the pitch of a vibrating string

There are three ways to change the pitch of a vibrating string. String instruments are tuned by varying the strings' tension because adjusting length or mass per unit length is impractical. Instruments with a fingerboard are then played by adjusting the length of the vibrating portion of the strings. The following observations all apply to a string that is infinitely flexible strung between two fixed supports. Real strings have finite curvature at the bridge and nut, and the bridge, because of its motion, are not exactly nodes of vibration. Hence the following statements about proportionality are (usually rather good) approximations.

Length

Pitch can be adjusted by varying the length of the string. A longer string will result in a lower pitch, while a shorter string will result in a higher pitch. The frequency is inversely proportional to the length:

$$f \propto \frac{1}{l}$$

A string twice as long will produce a tone of half the frequency (one octave lower).

Tension

Pitch can be adjusted by varying the tension of the string. A string with less tension (looser) will result in a lower pitch, while a string with greater tension (tighter) will result in a higher pitch. The frequency is proportional to the square root of the tension:

$$f \propto \sqrt{T}$$

Density

The pitch of a string can also be varied by changing the linear density (mass per unit length) of the string. The frequency is inversely proportional to the square root of the linear density:

$$f \propto \frac{1}{\sqrt{\mu}}$$

A string that is has a higher mass per unit length will produce a lower pitch.

String length or scale length

This is the length of the string from nut to bridge on bowed or plucked instruments and ultimately determines the distance between different notes on the instrument. For example, a double bass with its low range needs a scale length of around 42 inches (110 cm), whilst a violin scale is only about 13 inches (33 cm). On the shorter scale of the violin, the left hand may easily reach a range of slightly more than two octaves without shifting position, while on the bass' longer scale, a single octave or a ninth is reachable in lower positions.

Contact points along the string

The strings of a piano

In bowed instruments, the bow is normally placed perpendicularly to the string, at a point half way between the end of the fingerboard and the bridge. However, different bow placements can be selected to change timbre. Application of the bow close to the bridge (known as *sul ponticello*) produces an intense, sometimes harsh sound, which acoustically emphasizes the upper harmonics. Bowing above the fingerboard (*sul tasto*) produces a purer tone with less overtone strength, emphasizing the fundamental, also known as *flautando*, since it sounds less reedy and more flute-like.

Similar timbral distinctions are also possible with plucked string instruments by selecting an appropriate plucking point, although the difference is perhaps more subtle.

In keyboard instruments, the contact point along the string (whether this be hammer, tangent, or plectrum) is a choice made by the instrument designer. Builders use a combination of experience and acoustic theory to establish the right set of contact points.

In harpsichords, often there are two sets of strings of equal length. These "choirs" usually differ in their plucking points. One choir has a "normal" plucking point, producing a canonical harpsichord sound; the other has a plucking point close to the bridge, producing a reedier "nasal" sound rich in upper harmonics.

Production of multiple notes

A string at a certain tension and length will only produce one note, so to obtain multiple notes, string instruments employ one of two methods. One is to add enough strings to cover the range of notes desired; the other is to allow the strings to be *stopped*. The piano and harp are examples of the former method, where each note on the instrument has its own string or course of multiple strings. (Many notes on a piano are strung with a "choir" of three strings tuned alike.)

Some zithers combine stoppable (melody) strings with a greater number of "open" harmony or chord strings. On instruments with stoppable strings, such as the violin or guitar, the player can shorten the vibrating length of the string, using their fingers directly (or more rarely through some mechanical device, as in the nyckelharpa or the hurdy gurdy). Such instruments usually have a *fingerboard* attached to the neck of the instrument, that provides a hard flat surface athe player can stop the strings against. On some string instruments, the fingerboard has *frets*, raised ridges perpendicular to the strings that stop the string at precise intervals, in which case the fingerboard is also called

a *fretboard*.

Moving frets during performance is usually impractical. The bridges of a koto, on the other hand, may be moved by the player, occasionally in the course of a single piece of music. Many modern Western harps include levers, either directly moved by fingers (on Celtic harps) or controlled by foot pedals (on orchestral harps), to raise the pitch of individual strings by a fixed amount. The middle Eastern zither, the qanun, is equipped with small levers called *mandal* that allow each course of multiple strings to be incrementally retuned "on the fly" while the instrument is being played. These levers raise or lower the pitch of the string course by a microtone, less than a half step.

Sympathetic strings

Some instruments are employed with sympathetic strings, additional strings not meant to be plucked. These strings resonate along with the played notes. This system is for instance present on a sarangi.

Sound production

Acoustic instruments

It is sometimes said that the sounding board or soundbox "amplifies" the sound of the strings. Technically speaking, no amplification occurs, because all of the energy to produce sound comes from the vibrating string. What really happens is that the sounding board of the instrument provides a larger surface area to create sound waves than that of the string. A larger vibrating surface moves more air, hence produces a louder sound.

Achieving a tonal characteristic that is effective and pleasing to the player's and listener's ear is something of an art, and the makers of string instruments often seek very high quality woods to this end, particularly spruce (chosen for its lightness, strength and flexibility) and maple (a very hard wood). Spruce is used for the sounding boards of instruments from the violin to the piano.

Acoustic instruments can also be made out of artificial materials, such as carbon fiber and fiberglass (particularly the larger instruments, such as cellos and basses).

In the early 20th century, the Stroh violin used a diaphragm-type resonator and a metal horn to project the string sound, much like early mechanical gramophones. Its use declined beginning about 1920, as electronic amplification came into use.

Electronic amplification

Most string instruments can be fitted with piezoelectric or magnetic pickups to convert the string's vibrations into an electrical signal that is amplified and then converted back into sound by loudspeakers. Some players attach a pickup to their traditional string instrument to "electrify" it. Another option is to use a solid-bodied instrument, which reduces unwanted feedback howls or squeals.

Amplified string instruments can be much louder than their acoustic counterparts, which allows them to be used in relatively loud rock, blues, and jazz ensembles. Amplified instruments can also have their amplified tone modified by using electronic effects such as distortion, reverb, or wah-wah.

Bass-register string instruments such as the double bass and the electric bass are amplified with bass instrument amplifiers that are designed to reproduce low-frequency sounds. To modify the tone of amplified bass instruments, a range of electronic bass effects are available, such as distortion and chorus.

External links

- The physics of the bowed string [1]
- Instruments in Depth: The Viola [2], an online feature presented by Bloomingdale School of Music (2010)
- Chisholm, Hugh, ed (1911). "Stringed instruments". *Encyclopædia Britannica* (11th ed.). Cambridge University Press.

References

[1] http://www.phys.unsw.edu.au/jw/Bows.html
[2] http://www.bsmny.org/features/iidviola

Wind instrument

A **wind instrument** is a musical instrument that contains some type of resonator (usually a tube), in which a column of air is set into vibration by the player blowing into (or over) a mouthpiece set at the end of the resonator. The pitch of the vibration is determined by the length of the tube and by manual modifications of the effective length of the vibrating column of air. In the case of some wind instruments, sound is produced by blowing through a reed; others require buzzing into a metal mouthpiece.

Methods for obtaining different notes

- Changing the length of the vibrating air column, by changing the effective length of the tube through opening or closing holes in the side of the tube. This can be done by covering the holes with fingers or pressing a key which then closes the hole. This method is used in nearly all woodwind instruments.
- Changing the length of the vibrating air column, by changing the length of the tube, through engaging valves *(see rotary valve, piston valve)* which route the air through additional tubing, thereby increasing overall tube length, thereby lowering the fundamental pitch. This method is used on nearly all brass instruments.
- Changing the length of the vibrating air column, by lengthening and/or shortening the tube using a sliding mechanism. This method is used on the trombone and the slide whistle.
- Making the column of air vibrate at different harmonics, without changing the length of the column of air (see harmonic series).

All wind instruments use a combination of the first or second or third and the fourth method to extend their register.

Types of wind instruments

Wind instruments are typically grouped into two families: [1]

- Brass instruments
- Woodwind instruments

Although brass instruments were originally made of brass and woodwind instruments have traditionally been made of wood, the material used to make the body of the instrument is not always a reliable guide to its family type. A more accurate way to determine whether an instrument is brass or woodwind is to examine how the player produces sound. In brass instruments, the player's lips vibrate, causing the air within the instrument to vibrate. In woodwind instruments the player either:

- causes a reed to vibrate, which agitates the column of air (as in a clarinet, oboe or duduk)
- blows against an edge or fipple (as in a recorder), or
- blows across the edge of an open hole (as in a flute).

For example, the saxophone is typically made of brass, but is classified as a woodwind instrument because it produces sound with a vibrating reed.

On the other hand, the wooden cornett (not to be confused with the cornet, which is made of brass) and the serpent are both made of wood (or plastic tubing, in the case of modern serpents), but belong to the family of brass instruments because the vibrating is done by the player's lips.

In the Hornbostel-Sachs scheme of musical instrument classification, wind instruments are classed as aerophones.

Physics of Sound Production

Sound production in all wind instruments depends on the entry of air into a flow-control valve attached to a resonant chamber (resonator). The resonator is typically a long cylindrical or conical tube, open at the far end. A pulse of high pressure from the valve will travel down the tube at the speed of sound. It will be reflected from the open end as a return pulse of low pressure. Under suitable conditions, the valve will reflect the pulse back, with increased energy, until a standing wave forms in the tube.

Reed instruments such as the clarinet or oboe have a flexible reed or reeds at the mouthpiece, forming a pressure-controlled valve. An increase in pressure inside the chamber will decrease the pressure differential across the reed; the reed will open more, increasing the flow of air. [2] [3] The increased flow of air will increase the internal pressure further, so a pulse of high pressure arriving at the mouthpiece will reflect as a higher-pressure pulse back down the tube. Standing waves inside the tube will be odd multiples of a quarter-wavelength, [4] with a pressure anti-node at the mouthpiece, and a pressure node at the open end. The reed vibrates at a rate determined by the resonator.

For **Lip Reed** (brass) instruments, the player controls the tension in their lips so that they vibrate under the influence of the air flow through them. [5] [6] They adjust the vibration so that the lips are most closed, and the air flow is lowest, when a low-pressure pulse arrives at the mouthpiece, to reflect a low-pressure pulse back down the tube. Standing waves inside the tube will be odd multiples of a quarter-wavelength, with a pressure anti-node at the mouthpiece, and a pressure node at the open end.

For **Air Reed** (flute and fipple-flute) instruments, the flow of air over the mouth of the instrument forms a flow-controlled valve. [7] [8] Some of the air-stream flows into the instrument's mouth, leading to an increase in internal pressure, while some of the air-stream flows across the top of the mouth—through a Bernoulli effect this reduces the pressure at the mouth, drawing air out of the mouth and leading to a decrease in internal pressure. When the pressure inside the chamber decreases, more of the air-stream will enter the mouth, and less will flow across the top of the mouth. A pulse of high pressure arriving at the mouth will direct more air across the top of the mouth; this will decrease the internal pressure, and send a low-pressure pulse back down the tube. A pulse of low pressure arriving at the mouth will draw more air into the mouth; this will increase the internal pressure, and send a high-pressure pulse back down the tube. Standing waves inside the tube will be multiples of a half-wavelength, [9] with pressure nodes at both ends. The air-stream across the mouth vibrates at a rate determined by the resonator.

To a rough approximation, a tube of about 40 cm. will exhibit resonances near the following points:

- For a reed or lip-reed instrument: 220 Hz (A3), 660 Hz (E5), 1100 Hz (C#6).
- For an air-reed instrument: 440 Hz (A4), 880 Hz (A5), 1320 Hz (E6).

In practice, however, obtaining a range of musically useful tones from a wind instrument depends to a great extent on careful instrument design, and playing technique.

Parts

The **bell** of a wind instrument is the round, flared opening opposite the mouthpiece. It is found on horns, trumpets and many other kinds of instruments. On brass instruments, the acoustical coupling from the bore to the outside air occurs at the bell for all notes, and the shape of the bell optimizes this coupling. On woodwinds, most notes vent at the uppermost open tone holes; only the lowest notes of each register vent fully or partly at the bell, and the bell's function in this case is to improve the consistency in tone between these notes and the others.

The bell of a B Flat clarinet

References

[1] Baines, Anthony (1961). *Musical Instruments Through the Ages*. Harmondsworth: Pelican.
[2] Benade, Arthur H. (1990). *Fundamentals of Musical Acoustics*. New York: Dover. p. 491.
[3] Wolfe, Joe. "Clarinet Acoustics: an Introduction" (http://www.phys.unsw.edu.au/jw/clarinetacoustics.html). University of New South Wales. . Retrieved 2010-12-12.
[4] Wolfe, Joe. "Open vs. Closed Pipes" (http://www.phys.unsw.edu.au/jw/flutes.v.clarinets.html). University of New South Wales. . Retrieved 2010-12-12.
[5] Benade, Arthur H. (1990). *Fundamentals of Musical Acoustics*. New York: Dover. p. 391.
[6] Wolfe, Joe. "Brass Instrument (Lip Reed) Acoustics: an Introduction" (http://www.phys.unsw.edu.au/jw/brassacoustics.html). University of New South Wales. . Retrieved 2010-12-12.
[7] Benade, Arthur H. (1990). *Fundamentals of Musical Acoustics*. New York: Dover. p. 489.
[8] Wolfe, Joe. "Flute Acoustics: an Introduction" (http://www.phys.unsw.edu.au/jw/fluteacoustics.html). University of New South Wales. . Retrieved 2010-12-12.
[9] Wolfe, Joe. "Open vs. Closed Pipes" (http://www.phys.unsw.edu.au/jw/flutes.v.clarinets.html). University of New South Wales. . Retrieved 2010-12-12.

Wind Instrument Summary CDs are: "Microsoft Musical Instruments" (now out of production but sometimes available on Amazon), and "Tuneful Tubes?" (http://sites.google.com/site/tunefultubes)

External links

- Chisholm, Hugh, ed (1911). "wind instruments". *Encyclopædia Britannica* (11th ed.). Cambridge University Press.

Gamelan

Music of Indonesia
 Gongs from Java
Timeline • Samples
Genres
• Classical • Kecak • Kecapi suling • Tembang sunda • Pop • Dangdut • Hip hop • Kroncong • Gambang kromong • Gambus • Jaipongan • Langgam jawa • Pop Batak • Pop Minang • Pop Sunda • Qasidah modern • Rock • Tapanuli ogong • Tembang jawa
Specific Forms
• Gamelan • Angklung Beleganjur • Degung • Gambang • Gong gede • Gong kebyar • Jegog • Joged bumbung • Salendro • Selunding • Semar pegulingan
Regional Music

- Bali
- Borneo
- Java
- Moluccan Islands
- Papua
- Sulawesi
- Sumatra
- Sunda

A **gamelan** is a musical ensemble from Indonesia, typically from the islands of Bali or Java, featuring a variety of instruments such as metallophones, xylophones, drums and gongs; bamboo flutes, bowed and plucked strings. Vocalists may also be included.

The term refers more to the set of instruments than to the players of those instruments. A gamelan is a set of instruments as a distinct entity, built and tuned to stay together – instruments from different gamelan are generally not interchangeable.

The word *gamelan* comes from the Javanese word *gamels*, meaning "to strike or hammer", and the suffix *an*, which makes the root a collective noun.

History of gamelan music

Musicians performing musical ensemble, bas-relief of Borobudur.

Gamelan orchestra (1870-1891)

The gamelan predates the Hindu-Buddhist culture that dominated Indonesia in its earliest records and instead represents a native art form. The instruments developed into their current form during the Majapahit Empire.[1] In contrast to the heavy Indian influence in other art forms, the only obvious Indian influence in gamelan music is in the Javanese style of singing.[2]

In Javanese mythology, the gamelan was created by Sang Hyang Guru in Saka era 167 (c. AD 230), the god who ruled as king of all Java from a palace on the Maendra mountains in Medangkamulan (now Mount Lawu). He needed a signal to summon the gods and thus invented the gong. For more complex messages, he invented two other Gongs, thus forming the original gamelan set.[3]

The earliest image of a musical ensemble is found on the 8th century Borobudur temple, Central Java. Musical instruments such as the bamboo flute, bells, drums in various sizes, lute, and bowed and plucked string instruments were identified in this image. However it lacks metallophones and xylophones. Nevertheless, the image of this musical ensemble is suggested to be the ancient form of the gamelan.

In the palaces of Java are the oldest known ensembles, the Munggang and Kodokngorek gamelans, apparently from the 12th century. These formed the basis of a "loud style". A different, "soft style" developed out of the kemanak tradition and is related to the traditions of singing Javanese poetry, in a manner which is often believed to be similar to performance of modern bedhaya dance. In the 17th century, these loud and soft styles mixed, and to a large extent the variety of modern gamelan styles of Bali, Java, and Sunda resulted from different ways of mixing these elements. Thus, despite the seeming diversity of styles, many of the same theoretical concepts, instruments, and techniques are shared between the styles.[4]

Varieties of gamelan ensembles


Sundanese Gamelan Degung.

Varying forms of gamelan ensembles are distinguished by their collection of instruments and use of voice, tunings, repertoire, style, and cultural context. In general, no two gamelan ensembles are the same, and those that arose in prestigious courts are often considered to have their own style. Certain styles may also be shared by nearby ensembles, leading to a regional style.

The varieties are generally grouped geographically, with the principal division between the styles favored by the Balinese, Javanese, and Sundanese peoples. Sundanese gamelan is often associated with Gamelan Degung, a Sundanese musical ensemble that utilises a subset of modified gamelan instruments with a particular mode of pelog scale. Balinese gamelan is often associated with the virtuosity and rapid changes of tempo and dynamics of Gamelan gong kebyar, its best-known style. Other popular Balinese styles include Gamelan and kecak, also known as the "monkey chant." Javanese gamelan was largely dominated by the courts of the 19th century central Javanese rulers, each with its own style, but overall is known for a slower, more meditative style than that of Bali.


The all-bamboo Gamelan jegog from Bali

Outside of the main core on Java and Bali, gamelans have spread through migration and cultural interest, new styles sometimes resulting as well. Malay gamelans are designed in ways that are similar to the Javanese gamelan except they lack most of the elaborating instruments and are tuned in a near-equidistant slendro, often using a western Bb or C as a tuning basis. Javanese emigrants to Suriname play gamelan in a style close to that found in Central Javanese villages. Gamelan is also related to the Filipino kulintang ensemble. There is also a wide variety of gamelan in the West, including both traditional and experimental ensembles.


Javanese gamelan played also in Kuala Lumpur, Malaysia

Cultural context

In Indonesia, gamelan usually accompanies dance wayang puppet performances, or rituals or ceremonies. Typically players in the gamelan will be familiar with dance moves and poetry, while dancers are able to play in the ensemble. In wayang, the dalang (puppeteer) must have a thorough knowledge of gamelan, as he gives the cues for the music. Gamelan can be performed by itself – in "klenengan" style, or for radio broadcasts – but concerts in the Western style are not traditional.[5]

Gamelan's role in rituals is so important that there is a Javanese saying, "It is not official until the gong is hung."[6] Some performances are associated with royalty, such as visits by the sultan of Yogyakarta. Certain gamelans are associated with specific rituals, such as the Gamelan Sekaten, which is used in celebration of Mawlid an-Nabi (Muhammad's birthday). In Bali, almost all religious rituals include gamelan performance. Gamelan is also used in the ceremonies of the Catholic church in Indonesia.[7] Certain pieces are designated for starting and ending performances or ceremonies. When a "leaving" piece (such as "Udan Mas") is begun, the audience will know that the event is nearly finished and will begin to leave. Certain pieces are also believed to possess magic powers, and can be used to ward off evil spirits.[6]

Javanese gamelan ensemble with two female *sindhen* (choral singer) during traditional Javanese wedding at Sasono Utomo, Taman Mini Indonesia Indah, Jakarta, Indonesia

Gamelan is frequently played on the radio. For example, the Pura Pakualaman gamelan performs live on the radio every Minggu Pon (a day in the 35-day cycle of the Javanese calendar).[6] In major towns, the Radio Republik Indonesia employs professional musicians and actors, and broadcast programs of a wide variety of gamelan music and drama.[8]

In the court tradition of central Java, gamelan is often played in the pendopo, an open pavilion with a cavernous, double-pitched roof, no side walls, and a hard marble or tile floor. The instruments are placed on a platform to one side, which allows the sound to reverberate in the roof space and enhances the acoustics.[9]

In Bali, the Gamelan instruments are all kept together in the balai banjar, a community meeting hall which has a large open space with a roof over top of it with several open sides. The instruments are all kept here together because they believe that all of the instruments belong to the community as a whole and no one person has ownership over an instrument. Not only is this where the instruments are stored, but this is also the practice space for the sekaha (Gamelan orchestra). The open walls allow for the music to flow out into the community where the rest of the people can enjoy it.

The sekaha is led by a single instructor whose job it is in the community to lead this group and to come up with new songs. When they are working on a new song, the instructor will lead the group in practice and help the group form the new piece of music as they are practicing. When the instructor creates a new song, he leaves enough open for interpretation that the group can improvise and as a group they will be writing the music as they are practicing it.

The Balinese Gamelan groups are constantly changing their music by taking older pieces they know and mixing them together as well as trying new variations on their music. Their music is always constantly changing because they believe that music should grow and change; the only exception to this is with their most sacred songs which they will not change. A single new piece of music can take several months before it is completed.

Men and women usually perform in separate groups, with the exception of the pesindhen, the female singer who performs with male groups.[8]

In the West, gamelan is often performed in a concert context, but may also incorporate dance or wayang.

Tuning

Celempung – Indonesian Embassy in Canberra.

The tuning and construction of a gamelan orchestra is a complex process. Javanese gamelans use two tuning systems: *sléndro* and *pélog*. There are other tuning systems such as *degung* (exclusive to Sunda, or West Java), and *madenda* (also known as *diatonis*, similar to a European natural minor scale). In central Javanese gamelan, *sléndro* is a system with five notes to the diapason (octave), fairly evenly spaced, while *pélog* has seven notes to the octave, with uneven intervals, usually played in five note subsets of the seven-tone collection. This results in sound quite different from music played in a western tuning system. Many gamelan orchestras will include instruments in each tuning, but each individual instrument will only be able to play notes in one. The precise tuning used differs from ensemble to ensemble, and give each ensemble its own particular flavour. The intervals between notes in a scale are very close to identical for different instruments *within* each gamelan, but the intervals vary from one gamelan to the next.

Colin McPhee remarked, "Deviations in what is considered the same scale are so large that one might with reason state that there are as many scales as there are gamelans."[10] However, this view is contested by some teachers of gamelan, and there have been efforts to combine multiple ensembles and tuning structures into one gamelan to ease transportation at festival time. One such ensemble is gamelan Manikasanti, which can play the repertoire of many different ensembles.

Balinese gamelan instruments are commonly played in pairs which are tuned slightly apart to produce interference beats, ideally at a consistent speed for all pairs of notes in all registers. It is thought that this contributes to the very "busy" and "shimmering" sound of gamelan ensembles. In the religious ceremonies that contain gamelan, these interference beats are meant to give the listener a feeling of a god's presence or a stepping stone to a meditative state.

Notation

Traditionally gamelan music is not notated and began as an oral tradition; however, in the 19th century, the kratons of Yogyakarta and Surakarta developed distinct notations for transcribing the repertoire. These were not used to read the music, which was memorized, but to preserve pieces in the court records. The Yogyanese notation is a checkerboard notation, which uses six or seven vertical lines to represent notes of higher pitch in the balungan (core melody), and horizontal lines which represent the series of beats, read downward with time. The fourth vertical line and every fourth horizontal line (completing a gatra) are darkened for legibility. Symbols on the left indicate the colotomic structure of gongs and so forth, while specific drum features are notated in symbols to the right. The Solonese notation reads horizontally, like Western notation, but does not use barlines. Instead, note values and rests are squiggled between the notes.[11]

Today this notation is relatively rare, and has been replaced by kepatihan notation, which is a cipher system. Kepatihan notation developed around 1900 at the kepatihan in Surakarta. The pitches are numbered (see the articles on the scales slendro and pélog for an explanation of how), and are read across with dots and lines indicating the register and time values. Like the palace notations, however, they record only the balungan part, and to a large extent what is heard relies on memorized patterns the performers call upon during performance. However, teachers have also devised certain notations, generally using kepatihan principles, for the cengkok (melodic patterns) of each elaborating instrument. In ethnomusicological studies, transcriptions are often made onto a Western staff, sometimes with unusual clefs.[12]

Influence on Western music

The gamelan has been appreciated by several western composers of classical music, most famously Claude Debussy who heard a Javanese gamelan play at the Paris Exposition of 1889 (World's Fair). (The gamelan Debussy heard was in the *slendro* scale and was played by Central Javanese musicians.[13]) Despite his enthusiasm, direct citations of gamelan scales, melodies, rhythms, or ensemble textures have not been located in any of Debussy's own compositions. However, the equal-tempered whole tone scale appears in his music of this time and afterward,[14] and a Javanese gamelan-like heterophonic texture is emulated on occasion, particularly in "Pagodes", from *Estampes* (solo piano, 1903), in which the great gong's cyclic punctuation is symbolized by a prominent perfect fifth.

The composer Erik Satie, an influential contemporary of Debussy, also heard the Javanese gamelan play at the Paris Exposition of 1889. The repetitively hypnotic effects of the gamelan were incorporated into Satie's exotic Gnossienne set for piano.[15]

Direct homages to gamelan music are to be found in works for western instruments by John Cage, particularly his prepared piano pieces, Colin McPhee, Lou Harrison, Béla Bartók, Francis Poulenc, Olivier Messiaen, Pierre Boulez, Bronislaw Kaper and Benjamin Britten. In more recent times, American composers such as Henry Brant, Steve Reich, Philip Glass, Dennis Murphy, Loren Nerell, Michael Tenzer, Evan Ziporyn, Daniel James Wolf and Jody Diamond as well as Australian composers such as Peter Sculthorpe, Andrew Schultz and Ross Edwards have written several works with parts for gamelan instruments or full gamelan ensembles. I Nyoman Windha is among contemporary Indonesian composers that have written compositions using western instruments along with Gamelan. Hungarian composer György Ligeti wrote a piano étude called *Galamb Borong* influenced by gamelan. American folk guitarist John Fahey included elements of gamelan in many of his late-60s sound collages, and again in his 1997 collaboration with Cul de Sac, *The Epiphany of Glenn Jones.* The experimental art-rock band King Crimson, while not using gamelan instruments, used interlocking rhythmic paired guitars that were influenced by gamelan.[16] On the debut EP of Sonic Youth the track 'She's not Alone' has a gamelan timbre. Experimental pop groups The Residents, 23 Skidoo (whose 1984 album was even titled *Urban Gamelan*), Mouse on Mars, His Name Is Alive, Xiu Xiu, Macha, Saudade, The Raincoats and the Sun City Girls have used gamelan percussion. The gamelan has also been used by British multi-instrumentalist Mike Oldfield at least three times, "Woodhenge" (1979), "The Wind Chimes (Part II)" (1987) and "Nightshade" (2005). Avant-garde performance band Melted Men uses Balinese gamelan instruments as well as gamelan-influenced costumes and dance in their shows. The Moodswinger built by Yuri Landman gives gamelan–like clock and bell sounds, because of its 3rd bridge construction. Indonesian-Dutch composer Sinta Wullur has integrated Western music and gamelan for opera.

Influence on contemporary music

In contemporary Indonesian music scene, some groups fuse contemporary westernized jazz fusion music with the legacy of traditional ethnic music traditions of their people. In the case of Krakatau and SambaSunda, the bands from West Java, the traditional Sundanese kacapi suling and gamelan degung Sunda orchestra is performed alongside drum set, keyboard and guitars. Other bands such as Bossanova Java were fused Javanese music with bossanova, while the Kulkul band fuse jazz with Balinese gamelan.

The Indonesian born French singer Anggun, often incorporated Indonesian traditional tunes of gamelan and tembang style of singging in her works. Typical gamelan tunes can be trace in several songs in her album Snow on the Sahara such as Snow on the Sahara (song), A Rose in the Wind, and also in her collaboration works with Deep Forest on "Deep Blue Sea" on their 2002 album, "Music Detected". Philippines born Indonesian singer Maribeth Pascua also featuring gamelan tunes in her songs *Denpasar Moon* and *Borobudur*.

Recently, many Americans were first introduced to the sounds of gamelan by the popular anime film *Akira*. Gamelan elements are used in this film to punctuate several exciting fight scenes, as well as to symbolize the emerging psychic powers of the tragic hero, Tetsuo. The gamelan in the film's score was performed by the members of the

Japanese musical collective Geinoh Yamashirogumi, using their *semar pegulingan* and *jegog* ensembles. Gamelan and kecak are also used in the soundtrack to the video games *Secret of Mana* and *Sonic Unleashed*. The two opening credits of 1998 Japanese Anime Neo Ranga use Balinese music (Kecak and Gamelan gong kebyar). Each "waking up" of Ranga in the anime uses the Gong Kebyar theme. The musical soundtrack for the Sci Fi Channel series *Battlestar Galactica* features extensive use of the gamelan, particularly in the 3rd season,[17] as do Alexandre Desplat's scores for *Girl With A Pearl Earring* and *The Golden Compass*.

Loops of gamelan music appear in electronic music. An early example is the Texas band Drain's album *Offspeed and In There*, which contains two tracks where trip-hop beats are matched with gamelan loops from Java and Bali and recent popular examples include the Sofa Surfers' piece *Gamelan*, or *EXEC_PURGER/.#AURICA extracting*, a song sung by Haruka Shimotsuki as part of the Ar tonelico: Melody of Elemia soundtracks.

References

[1] The Embassy of the Republic of Indonesia, *Bulletin for National Museum of Canada* (Ottawa: April 1961), p.2, cited in Donald A. Lentz. *The Gamelan Music of Java and Bali: An Artistic Anomaly Complementary to Primary Tonal Theoretical Systems*. Lincoln: University of Nebraska Press, 1965. Page 5.
[2] Lentz, 5.
[3] R.T. Warsodiningrat, *Serat Weda Pradangga*. Cited in Roth, A. R. *New Compositions for Javanese Gamelan*. University of Durham, Doctoral Thesis, 1986. Page 4.
[4] Roth, 4–8
[5] Broughton, Simon, et al., eds. *World Music: The Rough Guide*. London: The Rough Guides, 1994. ISBN 1858280176. Page 419–420
[6] Broughton, 420
[7] Lindsay, 45
[8] Broughton, 421.
[9] Roth, 17
[10] Colin McPhee, *Music in Bali*. New Haven, CT: Yale University Press, 1966.
[11] Lindsay, Jennifer. *Javanese Gamelan*. Oxford: Oxford University Press, 1979. Pp. 27–28. ISBN 0195804139
[12] For example, in Sorrell, Neil. *A Guide to the Gamelan*. United Kingdom: Faber and Faber, 1990.
[13] Neil Sorrell. *A Guide to the Gamelan*. London: Faber and Faber, 2000. Pages 2–7 discuss the incident, about which much remains uncertain. In particular, it is unknown whether they played the Cirebonese instruments that the Paris Conservatoire received in 1887, which would be substantially different from their ordinary set, or if they brought their own set.
[14] Neil Sorrell. *A Guide to the Gamelan*. London: Faber and Faber, 2000. Although the five notes of the *slendro* set are closest in pitch to a pentatonic scale, this scale would have been familiar from other folk sources, as it is a common scale worldwide. It is the equally tempered whole-tone scale that is more analogous of the exotic *slendro* scale.
[15] Orledge, Robert*Satie the Composer (Music in the Twentieth Century)*Cambridge University Press (October 26, 1990)
[16] "" (http://www.progressiveears.com/frippbook/ch09.htm). Progressiveears.com. . Retrieved 2010-06-21.
[17] "SoundtrackNet 2/28/07 article" (http://www.soundtrack.net/news/article/?id=941). Soundtrack.net. 2007-02-28. . Retrieved 2010-06-21.

Further reading

Balinese gamelan

- *Balinese Music* (1991) by Michael Tenzer, ISBN 0-945971-30-3. Included is an excellent sampler CD of Balinese Music.
- *Gamelan Gong Kebyar: The Art of Twentieth-Century Balinese Music* (2000) by Michael Tenzer, ISBN 0-226-79281-1 and ISBN 0-226-79283-8.
- *Music in Bali* (1966) by Colin McPhee. New Haven, CT: Yale University Press.
- *Music in Bali: Experiencing Music, Expressing Culture* (2007) by Lisa Gold, Oxford University Press, New York, ISBN 0-195-14149-0 (paper)

Javanese gamelan

- *Gamelan: Cultural Interaction and Musical Development in Central Java* (1995) by Sumarsam, ISBN 0-226-78010-4 (cloth) 0226780112 (paper)
- *Music in Central Java: Experiencing Music, Expressing Culture* (2007) by Benjamin Brinner, Oxford University Press, New York, ISBN 0-195-14737-5 (paper)
- *Music in Java: History Its Theory and Its Technique* (1949) edited by Jaap Kunst, ISBN 90-247-1519-9. An appendix of this book includes some statistical data on intervals in scales used by gamelans.
- *A Gamelan Manual: A Player's Guide to the Central Javanese Gamelan* (2005) by Richard Pickvance, Jaman Mas Books, London, ISBN 0-9550295-0-3

External links

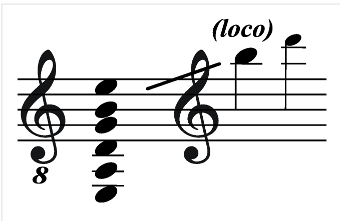
- Introduction to Gamelan Music (http://members.efn.org/~qehn/tutor/) by Qehn, Javanese only.
- Javanese gamelan notation (http://www.langensuka.asn.au/notation/) – prepared by Vi King Lim
- Javanese gamelan notation (http://www.gamelanbvg.com/gendhing/) – a huge collection maintained by Barry Drummond (in PDF format)
- Balinese and Javanese Gamelan (http://sinisterfrog.com/writings/gamelan)
- 'Gendèr barung pélong' from the Gamelan orchestra built in 1926-27 by Pontjopangrawit, at the National Museum Australia, Canberra (http://www.nma.gov.au/exhibitions/australian_journeys/gallery_highlights/slideshow_5_3.html#slideTop)

Electric guitar

Electric guitar

Fender Stratocaster

String instrument	
Classification	String instrument (plucked, either by fingerpicking, or with a pick.)
Hornbostel-Sachs classification	321.322 (Composite chordophone)
Playing range	



(a standard tuned guitar)

An **electric guitar** is a guitar that uses the principle of direct electromagnetic induction to convert vibrations of its metal strings into electric audio signals. The signal generated by an electric guitar is too weak to drive a loudspeaker, so it is amplified before sending it to a loudspeaker. Since the output of an electric guitar is an electric signal, the signal may easily be altered using electronic circuits to add "color" to the sound. Often the signal is modified using effects such as reverb and distortion.

Invented in 1931, the electric guitar became a necessity as jazz musicians sought to amplify their sound. Since then, the electric guitar has undeniably become one of the most important instruments in popular music around the world. It has evolved into a stringed musical instrument that is capable of a multitude of sounds and styles. It served as a major component in the development of rock and roll and countless other genres of music.

History

Various experiments at electrically amplifying the vibrations of a string instrument date back to the early part of the twentieth century. Patents from the 1910s show telephone transmitters adapted and placed inside violins and banjos to amplify the sound. Hobbyists in the 1920s used carbon button microphones attached to the bridge, however these detected vibration from the bridge on top of the instrument, resulting in a weak signal.[1] With numerous people experimenting with electrical instruments in the 1920s and early 1930s, there are many claimants to have been the first to invent an electric guitar.

Electric guitars were originally designed by guitar makers and instrument manufacturers. Guitar innovator Les Paul experimented with microphones attached to guitars. Some of the earliest electric guitars adapted hollow bodied acoustic instruments and used tungsten pickups. The first electrically amplified guitar was invented by George Beauchamp in 1931. Commercial production began in late summer of 1932 by the Ro-Pat-In Corporation (Elect**ro**-**Pat**ent-**In**strument Company Los Angeles),[2] [3] a partnership of Beauchamp, Adolph Rickenbacker, and Paul Barth. The wooden body of the prototype was built by Harry Watson, a craftsman who had worked for the National Resophonic Guitar Company (where the men met). By 1934 the company was renamed Rickenbacker Electro Stringed Instrument Company.

The need for the amplified guitar became apparent during the big band era as orchestras increased in size, particularly when guitars had to compete with large brass sections. The first electric guitars used in jazz were hollow archtop acoustic guitar bodies with electromagnetic transducers. By 1932 an electrically amplified guitar was commercially available. Early electric guitar manufacturers include: Rickenbacker (first called Ro-Pat-In) in 1932, Dobro in 1933, National, AudioVox and Volu-tone in 1934,Vega, Epiphone (Electrophone and Electar), and Gibson in 1935 and many others by 1936.

The solid body electric guitar is made of solid wood, without functionally resonating air spaces. Rickenbacher offered a cast aluminum electric steel guitar, nicknamed "The Frying Pan" or "The Pancake Guitar", developed in 1931 with production beginning in the summer of 1932. This guitar sounds quite modern and aggressive.

The first solid body "Spanish" standard guitar was offered by Vivi-Tone no later than 1934. An example of this model, featuring a guitar-shaped body of a single sheet of plywood affixed to a wood frame. Another early, substantially solid Spanish electric guitar, called Electro Spanish, was marketed by the "Rickenbacker" guitar company in 1935 and made of Bakelite. By 1936, the Slingerland company introduced a wooden solid body electric model.

The earliest documented performance with an electrically amplified guitar was in 1932, by Gage Brewer.[1] The Wichita, Kansas-based musician had an Electric Hawaiian A-25 (frypan, lap-steel) and a standard Electric Spanish from George Beauchamp of Los Angeles, California. Brewer publicized his new instruments in an article in the *Wichita Beacon* of October 2, 1932 and through performances that month.

The first recordings using the electric guitar were by Hawaiian style players, in 1933. Bob Dunn of Milton Brown's Musical Brownies introduced the electric Hawaiian guitar to Western Swing with his January 1935 Decca recordings, departing almost entirely from Hawaiian musical influence and heading towards Jazz and Blues. Alvino Rey was an artist who took this instrument to a wide audience in a large orchestral setting and later developed the pedal steel guitar for Gibson. An early proponent of the electric Spanish guitar was jazz guitarist George Barnes who used the instrument in two songs recorded in Chicago on March 1, 1938, "Sweetheart Land" and "It's a Low-Down Dirty Shame". Some incorrectly attribute the first recording to Eddie Durham, but his recording with the Kansas City Five was 15 days later.[4] Durham introduced the instrument to a young Charlie Christian, who made the instrument famous in his brief life and would be a major influence on jazz guitarists for decades thereafter.

Gibson's first production electric guitar, marketed in 1936, was the ES-150 model ("ES" for "Electric Spanish"; and "150" reflecting the $150 price of the instrument, along with a matching amplifier). The ES-150 guitar featured a single-coil, hexagonally shaped "bar" pickup, which was designed by Walt Fuller. It became known as the "Charlie Christian" pickup (named for the great jazz guitarist who was among the first to perform with the ES-150 guitar). The ES-150 achieved some popularity, but was suffered from unequal loudness across the six strings.

At an Engineering Fair in 1940, first prize went to NC State University physics professor Sidney Wilson for his invention of the world's first fully electric guitar. Wilson's guitar was also the first to have single-string pick-up, which addressed the unequal loudness problem of the ES-150's single coil. Professor Wilson also disposed of the acoustical body, reasoning that it was not necessary for a fully electric instrument. He developed the guitar shown here [5] and entered it in the annual engineering fair. Patents from academia were quite unusual in the 1940s, so Professor Wilson did not patent his invention. In 1949 Gibson incorporated both the individual string pick-up and the

cut-away body in its model ES-175. The design was attributed to Ted McCarthy of Gibson Corporation, but the features were first conceived and implemented by NC State physicists.

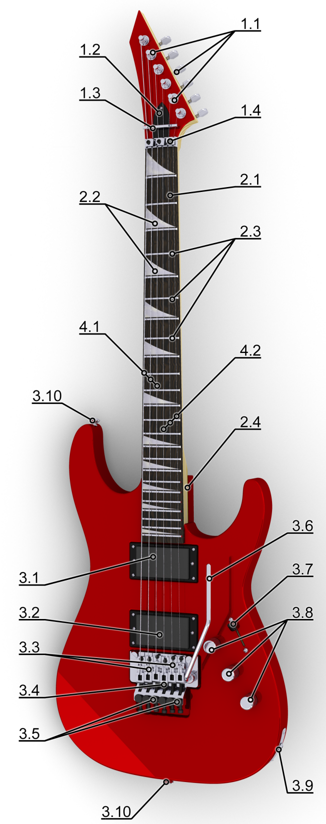
Early proponents of the electric guitar on record include: Jack Miller (Orville Knapp Orchestra), Alvino Rey (Phil Spitalney Orchestra), Les Paul (Fred Waring Orchestra), Danny Stewart (Andy Iona Orchestra), George Barnes (under many aliases), Lonnie Johnson, Floyd Smith, Big Bill Broonzy, T-Bone Walker, George Van Eps, Charlie Christian (Benny Goodman Orchestra) Tampa Red, Memphis Minnie, and Arthur Crudup.

A functionally solid body electric guitar was designed and built by Les Paul from an Epiphone acoustic archtop. His "log guitar" (so called because it consisted of a simple 4x4 wood post with a neck attached to it and homemade pickups and hardware, with two detachable Swedish hollow body halves attached to the sides for appearance only) shares nothing in design or hardware with the solid body "Les Paul" model sold by Gibson. However, the feedback problem associated with hollow-bodied electric guitars was understood long before Paul's "log" was created in 1940; Gage Brewer's Ro-Pat-In of 1932 had a top so heavily reinforced that it essentially functioned as a solid-body instrument.[1]

In 1945, Richard D. Bourgerie made an electric guitar pickup and amplifier for professional guitar player George Barnes. Bourgerie worked through World War II at Howard Radio Company making electronic equipment for the American military. Barnes showed the result to Les Paul, who then arranged for Bourgerie to have one made for him.

Construction

While guitar construction has many variations, in terms of the materials used for the body, the shape of the body, and the configuration of the neck, bridge, and pickups, there are features which are found in most guitars. The photo below shows the different parts of an electric guitar. The headstock (1) contains the metal machine heads, which are used for tuning; the nut (1.4), a thin fret-like strip of metal, plastic, graphite or bone which the strings pass over as they first go onto the fingerboard; the machine heads (1.1), which are worm gears which the player turns to change the string tension and thus adjust the tuning; the frets (2.3), which are thin metal strips which stop the string at the correct pitch when a string is pressed down against the fingerboard; the truss rod (1.2), a metal cylinder used for adjusting the tension on the neck (not found on all instruments); decorative inlay (2.2), a feature used to keep place of where the notes of the guitar are.



Legend: 1. Headstock: 1.1 machine heads 1.2 truss rod cover 1.3 string guide 1.4 nuttgyhnujn 2. Neck: 2.1 fretboard 2.2 inlay fret markers 2.3 frets 2.4 neck jointg 3. Body 3.1 "neck" pickup 3.2 "bridge" pickup 3.3 saddles 3.4 bridge 3.5 fine tuners 3.6 tremolo arm (whammy bar) 3.7 pickup selector switch 3.8 volume and tone control knobs 3.9 output connector (input jack)(TRS) 3.10 strap buttons 4. Strings: 4.1 bass strings 4.2 treble strings

The neck and the fretboard (2.1) extend from the body; at the neck joint (2.4), the neck is either glued or bolted to the body; the body (3) of this instrument is made of wood which is painted and lacquered, but some guitar bodies are also made of polycarbonate or other materials; pickups (3.1, 3.2), which are usually magnetic pickups, but which may also be piezoelectric transducer pickups; the control knobs (3.8) for the volume and tone potentiometers; a fixed bridge (3.4) -on some guitars, a spring-loaded hinged bridge called a "tremolo system" is used instead, which allows players to "bend" notes or chords down in pitch or perform a vibrato embellishment; and a plastic pickguard, a feature not found on all guitars, which is used to protect the body from scratches or cover the control cavity which holds most of the electric guitar's wiring.

The wood that the body (3) is made of is a very disputed subject considered by some to largely determine the sonic qualities of the guitar, while others believe that the sonic difference in a solid body guitar is very subtle between woods. In acoustic and archtop guitars there is a more pronounced sonic definition caused by the type of wood used. Typical woods include alder (brighter, but well rounded), swamp ash (similar to alder, but with more pronounced highs and lows), mahogany (dark, bassy, warm), poplar (similar to alder) and basswood (very neutral). Maple, a very bright tonewood, is also a popular body wood, but is very heavy. For this reason it is often placed as a 'cap' on a guitar made of primarily of another wood. Cheaper guitars are often made of cheaper woods, such as plywood, pine or agathis, not true hardwoods, which can affect the durability and tone of the guitar.Although most guitars are made from wood, any material may be used in the construction of a guitar. Materials such as plastic or cardboard are examples of unusual but possible materials that affect the overall sound of the guitar.

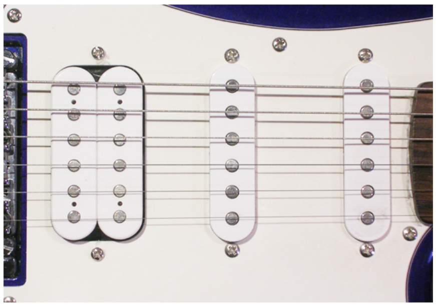
The output jack normally uses a TRS connector.

Pickups

Compared to an acoustic guitar, which has a hollow body, electric guitars make comparatively little audible sound simply by having their strings plucked, and so electric guitars are normally plugged into a guitar amplifier, which makes the sound louder. When an electric guitar is strummed, the movement of the strings generates (i.e., "induces") a very small electric current in the magnetic pickups, which are magnets wrapped with coils of very fine wire. That

current is then sent through a cable to a guitar amplifier.[6] The current induced is proportional to such factors as the density of the string or the amount of movement over these pickups. That vibration is, in turn, affected by several factors, such as the composition and shape of the body.

Some "hybrid" electric-acoustic guitars are equipped with additional microphones or piezoelectric pickups (transducers) that sense mechanical vibration from the body. Because in some cases it is desirable to isolate the pickups from the vibrations of the strings, a guitar's magnetic pickups will sometimes be embedded or "potted" in epoxy or wax to prevent the pickup from having a microphonic effect.



A close-up of the pickups on a Fender Squier "Fat Strat" guitar; on the left is a "humbucker" pickup and on the right are two single-coil pickups.

Because of their natural inductive qualities, all magnetic pickups tend to pick up ambient and usually unwanted electromagnetic noises. The resulting noise, the so-called "hum", is particularly strong with single-coil pickups, and aggravated by the fact that very few guitars are correctly shielded against electromagnetic interference. The most frequent cause is the strong 50 or 60 Hz component that is inherent in the generation of electricity in the local power transmission system. As nearly all amplifiers and audio equipment associated with electrical guitars rely on this power, there is in theory little chance of completely eliminating the introduction of unwanted hum.

Double-coil or "humbucker" pickups were invented as a way to reduce or counter the unwanted ambient hum sounds (known as 60 cycle hum). Humbuckers have two coils of opposite magnetic and electric polarity. This means that electromagnetic noise hitting both coils should cancel itself out. The two coils are wired in phase, so the signal picked up by each coil is added together. This high combined inductance of the two coils leads to the richer, "fatter" tone associated with humbucking pickups. Optical pickups are a type of pickup which sense string and body vibrations using infrared LED light.

Vibrato arms

Some electric guitars have a tremolo arm (sometimes called a "whammy bar" or "vibrato arm" and occasionally abbreviated as *trem.* Technically, "vibrato arm" is correct, since moving the arm creates vibrato, not tremolo.), a lever attached to the bridge which can slacken or tighten the strings temporarily, changing the pitch, thereby creating a vibrato or a portamento effect. The name "tremolo bar" is somewhat misleading. It would be more accurate and appropriate to call it a vibrato bar. Tremolo is a fluctuation of volume. Vibrato is a fluctuation of pitch, which is what the whammy bar produces. Early vibrato systems, such as the Bigsby vibrato tailpiece, tended to be unreliable and cause the guitar to go out of tune quite easily, and also had a limited range. Later Fender designs were better, but Fender held the patent on these, so other companies used Bigsby-style vibrato for many years.

Detail of a Squier-made Fender Stratocaster. Note the vibrato arm, the 3 single-coil pickups, the volume and tone knobs.

With the expiration of the Fender patent on the Stratocaster-style vibrato, various improvements on this type of internal, multi-spring vibrato system are now available. Floyd Rose introduced one of the first improvements on the vibrato system in many years when in the late 1970s he began to experiment with "locking" nuts and bridges which work to prevent the guitar from losing tuning even under the most heavy whammy bar acrobatics.

Guitar necks

Electric guitar necks can vary according to composition as well as shape. The primary metric used to describe a guitar neck is the *scale*, which is the overall length of the strings from the nut to the bridge. A typical Fender guitar uses a 25.5 inch scale, while Gibson uses a 24.75 inch scale in their *Les Paul*. While Gibson's scale has often claimed to be 24.75", it has varied through the years by as much as a half inch. The frets are placed proportionally according to the scale length; thus, the smaller the scale, the tighter the spacing of the frets.

Necks are described as *bolt-on*, *set-in*, or *neck-through* depending on how they are attached to the body. Set-in necks are glued to the body in the factory, and are said to have a warmer tone and greater sustain; this is the most traditional type of joint. Bolt-on necks were pioneered by Leo Fender to facilitate easy adjustment and replacement of the guitar neck. Neck-through instruments extend the neck itself to form the center of the guitar body, and are known for long sustain and for being particularly sturdy. While a set neck can be carefully unglued by a skilled luthier, and a bolt-on neck can simply be unscrewed, a neck-through design is difficult or even impossible to repair, depending on the damage. Historically, the bolt-on style has been more popular for ease of installation and adjustment; since bolt-on necks can be easily removed, there is an after-market in replacement bolt-on necks from companies such as Warmoth and Mighty Mite. Some instruments, notably most Gibson models, have continued to use set/glued necks. Neck-through bodies are somewhat more common in bass guitars.

The materials used in the manufacture of the neck have great influence over the tone of the instrument. Hardwoods are very much preferred, with maple, ash, and mahogany topping the list. The neck and fingerboard can be made from different materials, such as a maple neck with a rosewood fingerboard. In the 1980s, exotic man-made materials such as graphite began to be used, but are pricey and never have replaced wood in production instruments. Such necks can be retrofitted to existing bolt-on instruments.

There are several different neck shapes used on guitars, including shapes known as C necks, U necks, and V necks. These refer to the cross-sectional shape of the neck (especially near the nut). There are also several sizes of fret wire available, with traditional players often preferring thin frets, and metal shredders liking thick frets. Thin frets are considered better for playing chords, while thick frets allow lead guitarists to bend notes with less effort. An electric guitar with a neck which folds back called the "Foldaxe" was designed and built for Chet Atkins by Roger C. Field (featured in Atkins' book "Me and My Guitars."). Steinberger guitars developed a line of exotic instruments without headstocks, with tuning done on the bridge instead.

Sound and effects

While an acoustic guitar's sound is largely dependent on the vibration of the guitar's body and the air within it, the sound of an electric guitar is largely dependent on a magnetically induced electrical signal, generated by the vibration of metal strings near sensitive pickups. The signal is then "shaped" on its path to the amplifier by using a range of effect devices or circuits that modify the tone and characteristics of the signal. The amplifiers and speakers used also add (intentional) coloration to the final sound.

Built-in sound shaping

Electric guitars usually have up to three magnetic pickups. Identical pickups will have different tones depending on how near they are to the neck or bridge, with bridge pickups having a bright or trebly timbre, and neck pickups being more warm or bassy. The type of pickup also affects tone, with dual-coil pickups sounding warmer, thicker, perhaps even muddy, and single coil pickups sounding clear, bright, perhaps even biting. Guitars do not have to be fitted with a uniform type of pickup: a common mixture is the "fat strat" arrangement of one dual-coil at the bridge position, with single coils in the middle and neck positions.

Where there is more than one pickup, selector switching is fitted. These often allow the outputs of two or more pickups to be combined, so that two-pickup guitars have three-way switches, and three-pickup guitars have five-way

switches. Further circuitry is sometimes provided to combine the pickups in different ways. For instance, phase switching places one pickup out of phase with the other(s), leading to a "honky", "nasal", or "funky" sound. Individual pickups can also have their timbre altered by switches, typically coil tap switch, which effectively short-circuits some of a dual-coil pickup's windings, giving a tone like a single coil pickup.

The final stages of on-board sound-shaping circuitry are the volume control (potentiometer) and tone control (which "rolls off" the treble frequencies). Where there are individual volume controls for different pickups, and where pickup signals can be combined, they would affect the timbre of the final sound by adjusting the balance between pickups from a straight 50:50.

The strings fitted to the guitar also have an influence on tone. Rock musicians often prefer the lightest gauge of roundwound string, which are easier to bend, while jazz musicians go for heavier, flatwound strings with a rich, dark sound.

Recent guitar designs may incorporate much more complex circuitry than described above: see Digital and synthesizer guitars, below.

Classic amplifier sounds

In the 1960s, some guitarists began exploring a wider range of tonal effects by distorting the sound of the instrument. To do this, they used overdrive — increasing the gain, of the preamplifier beyond the level at which the signal could be faithfully reproduced, resulting in a "fuzzy" sound. This effect is called "clipping" by sound engineers, because when viewed with an oscilloscope, the wave forms of a distorted signal appear to have had their peaks "clipped off", approximating a square wave. This was not actually a new development in the instrument, but rather a shift of aesthetics, the sound having not been recognized as desirable previously.

Distortion achieved by overdrive necessarily involves high volumes and is therefore often combined with audio feedback.

After distortion became popular, amplifier manufacturers included various provisions for it, making amps easier to overdrive, and providing separate "dirty" and "clean" channels so that distortion could easily be switched in and out. The distortion characteristics of vacuum tube amplifiers are particularly sought-after, and various attempts have been made to emulate them without the disadvantages (fragility, low power, expense) of actual tubes.

Guitar amplifiers have long included at least a few effects, often tone controls and a spring reverb unit. The use of offboard effects is assisted by the provision of effect loops, an arrangement that allows effects to be taken out of circuit when not required.

Effects units

In the 1960s, the tonal palette of the electric guitar was further modified by introducing an Effects unit in its signal path. modifiers, wave-shaping circuits, voltage-controlled oscillators, or digital delays. Effects units come in several formats, the most common of which are the stomp-box and the rack-mount unit. A "stomp box" (or "pedal") is a small metal or plastic box containing the circuitry which is placed on the floor in front of the musician and connected in line with the patch cord connected to the instrument. The box is typically controlled by one or more foot-pedal on-off switches and it typically contains only one or two effects. "Guitar pedalboards" are used by musicians who use multiple stomp-boxes; these may be a DIY project made with plywood or a commercial pedalboard.

A Boss distortion pedal in use.

A rack-mount effects unit may contain the identical electronic circuit, but is mounted in a standard 19" equipment rack. Usually, however, rack-mount effects units contain several different types of effects. They are typically controlled by knobs or switches on the front panel, and often by a MIDI digital control interface.

Typical effects include:-

- Effects such as stereo chorus, phasers and flangers which shift the pitch of the signal by a small and varying amount, creating swirling, shimmering and whooshing noises.
- Effects such as octavers, which displace pitch by an exact musical interval.
- Distortion, such as transistor-style fuzz, or effects incorporating or emulating vacuum tube distortion.
- Filters such as wah-wah
- Envelope shapers, such as compression/sustain or volume/swell.
- Time-shift effects such as delay and reverb.

Modern amplifier techniques

In the 1970s, as effects pedals proliferated, their sounds were combined with tube amp distortion at lower, more controlled volumes by using power attenuators such as Tom Scholz' Power Soak as well as re-amplified dummy loads such as Eddie Van Halen's use of a variac, power resistor, post-power-tube effects, and a final solid-state amp driving the guitar speakers. A variac is one approach to power-supply based power attenuation, to make the sound of power-tube distortion more practically available.

Recent amplifiers may include digital technology similar to modern effects pedals, including the ability to model or emulate a variety of classic amps.

Digital and software-based effects

A **multi-effects device** (also called a "multi-FX" device) is a single electronics effects pedal or rackmount device that contains many different electronic effects. In the late 1990s and throughout the 2000s, multi-FX manufacturers such as Zoom and Korg produced devices that were increasingly feature-laden. Multi-FX devices allow several of the effects to be used together, and most devices allow users to set "preset" combinations of different effects including distortion, chorus, reverb, compression, and so on. This allows musicians to have quick on-stage access to different effects combinations. Some multi-FX pedals contain modelled versions of well-known effects pedals or amplifiers.

The Zoom 505 multi-effect pedal.

The Boss GT-8 is a higher-end multi-effect processing pedal; note the preset switches and patch bank footswitches and built-in expression pedal.

Multi-effects devices have garnered a large share of the effects device market because they offer the user such a large variety of effects in a single package. A low-priced multi-effects pedal may provide 20 or more effects for the price of a regular single-effect pedal. More expensive multi-effect pedals may include 40 or more effects, amplifier modelling, and the ability to combine effects and/or modelled amp sounds in different combinations, as if the user was using multiple guitar amps. More expensive multi-effects pedals may also include more input and output jacks (e.g., an auxiliary input or a "dry" output), MIDI inputs and outputs, and an expression pedal, which can control volume or modify effect parameters (e.g., the rate of the simulated rotary speaker effect).

By the 1980s and 1990s, software effects became capable of replicating the analog effects used in the past. These new digital effects attempted to model the sound produced by analog effects and tube amps, to varying degrees of quality. There are many free guitar effects computer programs for computers that can be downloaded via the Internet. Now, computers with sound cards can be used as digital guitar effects processors. Although digital and software effects offer many advantages, many guitarists still use analog effects.

Synthesizer and digital guitars

In 2002, Gibson announced the first digital guitar, which performs analog-to-digital conversion internally. The resulting digital signal is delivered over a standard Ethernet cable, eliminating cable-induced line noise. The guitar also provides independent signal processing for each individual string. Also, in 2003 amp maker Line 6 released the Variax guitar. It differs in some fundamental ways from conventional solid-body electrics. For example it uses piezoelectric pickups instead of the conventional electromagnetic ones, and has an on-board computer capable of modifying the sound of the guitar to model the sound of many instruments.

Playing techniques

The sound of a guitar is not only adapted by electronic sound effects, but also heavily by all kinds of new techniques developed or becoming possible in combination with the electric amplification. This is called extended technique.


A prepared guitar

Extended techniques include:-

- String bending (or radial finger vibrato.). This is not quite unique to the electric instrument, but is greatly facilitated by the light strings typically used on solid body guitars.
- Neck bending, by holding the upper arm on the guitar body and bending the neck either to the front or pulling it back. This is used as a substitute for a tremolo bar, although not as effective and too powerful of force use could snap the guitar neck.
- The use of the whammy bar or "tremolo" arm, including the extreme technique of dive bombing.
- Tapping, in which both hands are applied to the fretboard. This is only feasible with the assistance of amplification.
- Pinch harmonics, sometimes called "squealies".
- Volume swells, in which the volume knob is repeatedly rolled to create a violin-like sound. Note that the same result can also be accomplished through the use of an external swell pedal, although the knob technique can enhance showmanship and conveniently eliminate the need for another pedal.
- Use of audio feedback to enhance sustain and change timbre.
- Substitution of another device for the plectrum, for instance the cello bow (as famously used by Jimmy Page) and the e-bow, (a device using electromagnetic feedback to vibrate strings without direct contact). Like feedback, these techniques increase sustain, bring out harmonics and change the acoustic envelope.
- Sustainers built into the guitar itself.
- Use of slide or bottlenecks.
- Sometimes guitars are even adapted with extra modifications to alter the sound, such as Prepared guitar and 3rd bridge.

Other techniques such as axial finger vibrato, pull-offs, hammer-ons, palm muting, harmonics and altered tunings are also used on the classical and acoustic guitar. Shred guitar is a genre involving a number of extended techniques.

Types

Solid body

Paul Reed Smith Standard 22

Solid body electric guitars have no hollow internal cavity to accommodate vibration and no sound holes such as those used to amplify string vibrations in acoustic guitars. Solid body instruments are generally made up of hardwood with a lacquer coating. The wood is dried for 3 to 6 months in heated storage before being cut to shape. The sound that is audible in music featuring electric guitars is produced by pickups on the guitar that convert the string vibrations into an electrical signal. The signal is then fed to an amplifier (or amp) and speaker.

One of the first solid body guitars was invented by Les Paul. Gibson did not present their 'Les Paul' guitar prototypes to the public, as they did not believe it would catch on. The first mass-produced solid-body guitar was Fender's Broadcaster (later to become the 'Telecaster') first made in 1948, five years after Les Paul made his prototype. The Gibson Les Paul appeared soon after to compete with the Broadcaster.[7]

String-through body

When discussing electric guitar construction, the term **string-through body** is used to describe a type of solid body electric guitar body in which the strings are threaded through holes drilled into the bottom of the guitar body. The strings are typically held in place using metal ferrules screwed or glued into the holes.

The advantages of a string-through body mostly relate to improvements in a guitar's sustain and timbre. It is also by nature impossible to install a tremolo arm and have the string ends anchored through the body without eliminating whatever tonal benefits provided by the string-through body system. Tremolo systems change string tension by changing the physical length of the string. This requires the end of the string to be anchored to the (tremolo) bridge unit directly, instead of to the wood of the body.

Examples of string-through bodies on guitars include the Fender Telecaster Thinline and Telecaster Deluxe.

Semi-acoustic

These guitars have a hollow body and electronic pickups mounted on its body. They work in a similar way to solid body electric guitars except that because the hollow body also vibrates, the pickups convert a combination of string and body vibration into an electrical signal. A variant form, the semi-hollow body guitar, strikes a balance between the characteristics of solid-body and hollow-body guitars. Advocates of semi-hollow-body guitars argue that they have greater resonance and sustain than true solid-body guitars,[8] as a solid wood body. Several metal bodies were made in the 1950s by violin and cello makers. In the 1970s, John Veleno made a polished aluminum guitar. Liquid Metal Guitars makes a metal body guitar made out of a solid block of aluminum and then chrome or gold-plates the instrument.


An Epiphone brand semi-acoustic hollow-body guitar.

Chambered

Many guitars otherwise sold as solid-bodied instruments, such as the Gibson Les Paul or the PRS Singlecut, are built with "weight relief" holes bored into the body which affect the sound of the instrument.[9] The Les Paul Supreme edition is currently described by the manufacturer as a "chambered" instrument, with a weight relief system designed to positively affect the sound.

Electric acoustic

Some steel-string acoustic guitars are fitted with pickups purely as an alternative to using a separate microphone. They may also be fitted with a piezoelectric pickup under the bridge, attached to the bridge mounting plate, or with a low mass microphone (usually a condenser mic) inside the body of the guitar that will convert the vibrations in the body into electronic signals, or even combinations of these types of pickups, with an integral mixer/preamp/graphic equalizer. These are called electric acoustic guitars, and are regarded as acoustic guitars rather than electric guitars because the pickups do not produce a signal directly from the vibration of the strings, but rather from the vibration of the guitar top or body.

These should not be confused with semi-acoustic guitars, which have pickups of the type found on solid body electric guitars, or solid-bodied hybrid guitars with piezoelectric pickups.

String, bridge, and neck variants

One-string

Although rare, the one-string guitar is sometimes heard, particularly in Delta blues, where improvised folk instruments were popular in the 1930s and 1940s. Eddie "One String" Jones had some regional success with a Mississippi blues musician Lonnie Pitchford played a similar, homemade instrument. In a more contemporary style, Little Willie Joe, the inventor of the Unitar, had a rhythm and blues instrumental hit in the 1950s with "Twitchy", recorded with the Rene Hall Orchestra.

Four-string

The best-known exponent of the four-string guitar, often called the tenor guitar was Tiny Grimes, who played on 52nd Street with the beboppers and played a major role in the Prestige Blues Swingers. Grimes' guitar omitted the bottom two strings. Deron Miller of CKY only uses four strings, but plays a six string guitar with the two highest strings removed. Many banjo players use this tuning: DGBE, mostly in Dixieland. Guitar players find this an easier transition than learning plectrum or tenor tuning.

Seven-string

Most Seven-string guitars add a low "B" string below the low "E". Both electric and classical guitars exist designed for this tuning. A high "A" string above the high "E" instead of the low "B" is sometimes used. Another less common seven-string arrangement is a second G string situated beside the standard G string and tuned an octave higher, in the same manner as a twelve-stringed guitar (see below). Jazz guitarists using a seven-string include veteran jazz guitarists George Van Eps, Lenny Breau, Bucky Pizzarelli and his son John Pizzarelli.

Seven-string electric guitars were popularized among rock players in the 1980s by Steve Vai. Along with the Japanese guitar company Ibanez, Vai created the Universe series seven string guitars in the 1980s, with a double locking tremolo system for a seven string guitar. These models were based on Vai's six string signature series, the Ibanez Jem. Seven-string guitars experienced a resurgence in popularity in the 2000s, championed by Limp Bizkit, Slayer, KoRn, Fear Factory, Strapping Young Lad, Nevermore, Muse and other hard rock/metal bands. Metal musicians often prefer the seven-string guitar for its extended lower range. The seven-string guitar has also played an essential role in progressive metal rock, and is commonly used in bands such as Dream Theater, Pain of Salvation and by experimental guitarists such as Ben Levin.

Eight and nine-string

Eight-string electric guitars are rare, but not unused. One is played by Charlie Hunter (manufactured by Novax Guitars). The largest manufacturer of 8- to 14-strings is Warr Guitars. Their models are used by Trey Gunn (ex King Crimson) who has his own *signature* line from the company. Also, Mårten Hagström and Fredrik Thordendal of Meshuggah used 8-string guitars made by Nevborn Guitars and now guitars by Ibanez.Alan Aldo of the band Mariachi Terror uses acoustic and electric 8 string guitars to produce his sound. Munky of nu metal band KoRn is also known to use seven-string Ibanez guitars and it is rumored that he is planning to release a K8 eight-string guitar similar to his K7 seven-string guitar. Another Ibanez is Tosin Abasi, lead guitar player of progressive metal band Animals as Leaders, who uses an Ibanez RG2228 to mix bright chords with very heavy low riffs on the 7 and 8th strings. Stephen Carpenter of Deftones also switched from 7 to 8 string in 2008 and released his signature STEF B-8 with ESP Guitars. In 2008 Ibanez released the Ibanez RG2228-GK which is the first mass produced eight-string guitar. Jethro Tull's first album uses a nine-string guitar on one track. Minarik Guitars manufactures the "Inferno V" 9 stringed guitar that has the top three strings doubled up with strings that are an octave higher, like 12 stringed guitars. Bill Kelliher, guitarist for the heavy metal group Mastodon, worked with First Act on a custom mass-produced nine-string guitar.

Ten-string

B.C.Rich manufacture a ten-string six-course electric guitar known as the *Bich*, whose radical shape was specifically designed to allow the machine heads for the four secondary strings to be positioned on the body, avoiding the head-heaviness of many electric twelve-string guitars. However many players bought it for the body shape or electrics and simply removed the extra strings. The company recognized this and released six-string models of the Bich, but ten-string models also remain in production.

In October 2008, a ten-string electric jazz guitar by Mike Shishkov was demonstrated at the 3rd International Ten String Guitar Festival. This instrument was based on the ten-string extended-range classical guitar.

Twelve-string

Twelve string electric guitars feature six pairs of strings, usually with each pair tuned to the same note. The extra E, A, D, and G strings add a note one octave above, and the extra B and E strings are in unison. The pairs of strings are played together as one, so the technique and tuning are the same as a conventional guitar, although creating a much fuller tone. They are used almost solely to play harmony and rhythm. They are relatively common in folk rock music. Lead Belly is the folk artist most identified with the twelve-string guitar, usually acoustic with a pickup.

George Harrison of The Beatles and Roger McGuinn of The Byrds brought the electric twelve-string to notability in rock and roll. During the Beatles' first trip to the US, in February 1964, Harrison received a new "360/12" model guitar from the Rickenbacker company, a 12-string electric made to look onstage like a 6-string. He began using the 360 in the studio on Lennon's "You Can't Do That" and other songs. Roger McGuinn began using electric 12-string guitars to create the jangly sound of The Byrds. Another notable guitarist to utilize electric 12-string guitars is Jimmy Page, the guitarist with hard rock-heavy metal and rock group Led Zeppelin.

3rd bridge

The 3rd bridge guitar is an electric prepared guitar with an additional 3rd bridge. This can be a normal guitar with for instance a screwdriver placed under the strings, but can also be a custom made instrument. Lee Ranaldo of Sonic Youth plays with a 3rd bridge.

Double neck guitar

Double neck (or, less commonly, "twin-neck") guitars enable guitarists to play guitar and bass guitar or, more commonly, a six-string and twelve-string. In the mid-1960's, one of the first players to use this type of guitar was Paul Revere & the Raiders' guitarist Drake Levin. Another early user was John McLaughlin, but the double-neck guitar was popularized by Jimmy Page, who used a custom-made Gibson EDS-1275 to perform "Stairway to Heaven" and "The Song Remains the Same", although "Stairway to Heaven" was actually recorded using a Fender Telecaster. Don Felder of the Eagles also used the Gibson EDS-1275 during the Hotel California tour. Muse guitarist and vocalist Matthew Bellamy uses a silver Manson Double Neck on his bands' The Resistance Tour.

A white Gibson EDS-1275

Uses

Popular music

Popular music and rock groups often use the electric guitar in two roles: as a rhythm guitar which provides the chord sequence or "progression" and sets out the "beat" (as part of a rhythm section), and a lead guitar, which is used to perform melody lines, melodic instrumental fill passages, and guitar solos. In some rock or metal bands with two guitarists, the two performers may perform as a guitar tandem, and trade off the lead guitar and rhythm guitar roles. In bands with a single guitarist, the guitarist may switch between these two roles, playing chords to accompany the singer's lyrics, and then playing a guitar solo in the middle of the song.

In the most commercially available and consumed pop and rock genres, electric guitars tend to dominate their acoustic cousins in both the recording studio and the live venue, especially in the "harder" genres such as heavy metal and hard rock. However the acoustic guitar remains a popular choice in country, western and especially

bluegrass music, and it is widely used in folk music.

Jazz and jazz fusion

Jazz guitar playing styles include rhythm guitar-style "comping" (accompanying) with jazz chord voicings (and in some cases, walking basslines) and "blowing" (improvising solos) over jazz chord progressions with jazz-style phrasing and ornaments. The accompanying style for electric guitar in most jazz styles differs from the way chordal instruments accompany in many popular styles of music. In rock and pop, the rhythm guitarist usually performs the chords in rhythmic fashion which sets out the beat of a tune. In contrast, in many modern jazz styles, the guitarist plays much more sparsely, intermingling periodic chords and delicate voicings into pauses in the melody or solo. Jazz chord voicings are usually rootless and emphasize the 3rd and 7th notes of the chord.

When jazz guitar players improvise, they use the scales, modes, and arpeggios associated with the chords in a tune's chord progression. Jazz guitarists have to learn how to use scales (whole tone scale, chromatic scale, etc.) to solo over chord progressions. Jazz guitar improvising is not merely the recitation of jazz scales and rapid arpeggios. Jazz guitarists often try to imbue their melodic phrasing with the sense of natural breathing and legato phrasing used by horn players such as saxophone players. As well, a jazz guitarists' solo improvisations have to have a rhythmic drive and "time feel" that creates a sense of "swing" and "groove".

Most jazz guitarists play hollow body instruments, but solid body guitars are also used. Hollow body instruments were the first guitars used in jazz in the 1930s and 1940s. During the 1970s jazz fusion era, many jazz guitarists switched to the solid body guitars that dominated the rock world.

Contemporary classical music

Until the 1950s, the acoustic, nylon-stringed classical guitar was the only type of guitar favored by classical, or art music composers. In the 1950s a few contemporary classical composers began to use the electric guitar in their compositions. Examples of such works include Karlheinz Stockhausen's *Gruppen* (1955–57); Donald Erb's *String Trio* (1966), Morton Feldman's *The Possibility of a New Work for Electric Guitar* (1966); George Crumb's *Songs, Drones, and Refrains of Death* (1968); Hans Werner Henze's *Versuch über Schweine* (1968); Francis Thorne's *Sonar Plexus* (1968) and *Liebesrock* (1968–69), Michael Tippett's *The Knot Garden* (1965–70); Leonard Bernstein's *MASS* (1971) and *Slava!* (1977); Louis Andriessen's *De Staat* (1972–76); Helmut Lachenmann's *Fassade, für grosses Orchester* (1973, rev. 1987), Steve Reich's *Electric Counterpoint* (1987), Arvo Pärt's *Miserere* (1989/92), György Kurtág's *Grabstein für Stephan* (1989), and countless works composed for the quintet of Ástor Piazzolla. Alfred Schnittke also used electric guitar in several works, like the "Requiem", "Concerto Grosso N°2" and "Symphony N°1".

In the 1980s and 1990s, a growing number of composers (many of them composer-performers who had grown up playing the instrument in rock bands) began writing contemporary classical music for the electric guitar. These include Shawn Lane, Steven Mackey, Nick Didkovsky, Scott Johnson, Lois V Vierk, Tim Brady, Tristan Murail, John Rogers, and Randall Woolf.

Yngwie Malmsteen released his Concerto Suite for Electric Guitar and Orchestra in 1998, and Steve Vai released a double-live CD entitled *Sound Theories*, of his work with the Netherlands Metropole Orchestra in June 2007.[10] The American composers Rhys Chatham and Glenn Branca have written "symphonic" works for large ensembles of electric guitars, in some cases numbering up to 100 players, and the instrument is a core member of the Bang on a Can All-Stars (played by Mark Stewart). Still, like many electric and electronic instruments, the electric guitar remains primarily associated with rock and jazz music, rather than with classical compositions and performances.[11] R. Prasanna plays a style of Indian classical music (Carnatic music) on the electric guitar.

In the 21st century, European avant garde composers like Richard Barrett, Fausto Romitelli, Peter Ablinger, Bernhard Lang and Karlheinz Essl have used the electric guitar (together with extended playing techniques) in solo pieces or ensemble works. Probably the most ambitious and perhaps significant work to date is *Ingwe* (2003–2009)

by Georges Lentz (written for Australian guitarist Zane Banks), a 60-minute work for solo electric guitar, exploring that composer's existential struggles and taking the instrument into realms previously unknown in a concert music setting.

Notes

[1] Wheelwright and Carter

[2] Richard R. Smith. *The history of Rickenbacker guitars* (http://books.google.com/books?id=NlscjoFVcs0C&pg=PA10&dq=Ro-Pat-In+Corporation&hl=en&ei=QSXUTamQPNCRswbbk_niAg&sa=X&oi=book_result&ct=result&resnum=1&ved=0CDYQ6AEwAA#v=onepage&q=Ro-Pat-In Corporation&f=false). Centerstream Publications, 1987. p. 10. . Retrieved 18 May 2011.

[3] "Guitar E - berichte und fotos. ViewGoods.de" (http://www.viewgoods.de/allgemeine/guitar-e.html). *viewgoods.de*. . Retrieved 18 May 2011.

[4] Broadbent, p.59

[5] http://www.physics.ncsu.edu/news/physics_firsts_guitar.html

[6] Physics... in action (http://www.europhysicsnews.com/full/10/article2/article2.html)

[7] Alan Ratcliffe, *Electric Guitar Handbook* (UK: New Holland Publishers, 2005), p. 11

[8] Dave Hunter, *Chambering the Les Paul: A Marriage of Weight and Tone* (Gibson Lifestyle, 2007), "Chambering the Les Paul: A Marriage of Weight and Tone" (http://www.gibson.com/en-us/Lifestyle/ProductSpotlight/GearAndInstruments/Chambering the Les Paul_ A Mar/). .

[9] "Les Paul Forum Frequently Asked Questions" (http://www.lespaulforum.com/faqpage.html#weighti). .

[10] [vai.com - the official steve vai website] (http://vai.com/News/index.html)

[11] For more on this subject see Robert Tomaro's "Contemporary Compositional Techniques for the Electric Guitar in United States Concert Music," published in *The Journal for New Music Research*, v. 23, no. 4 (December 1994), pp. 349-367.

References

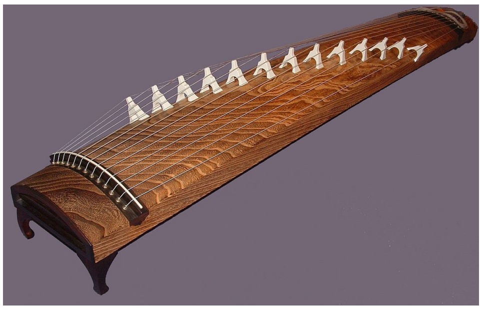
- Broadbent, Peter (1997). *Charlie Christian: Solo Flight – The Seminal Electric Guitarist*. Ashley Mark Publishing Company. ISBN 1-872639-56-9.
- Govenar, Alan B.; Jay F. Brakefield (1998). *Deep Ellum and Central Track: Where the Black and White Worlds of Dallas Converged*. University of North Texas Press. ISBN 1-57441-051-2.
- Millard, André, (ed.) (2004). *The Electric Guitar: A History of an American Icon*. The Johns Hopkins University Press. ISBN 0-8018-7862-4.
- Wheelwright, Lynn; Carter, Walter (28 April 2010). "Ro-Pat-In Electric Spanish" (http://www.vintageguitar.com/features/brands/details.asp?AID=3265). *Vintage Guitar*. Retrieved 8 August 2010.

External links

- Guitar Player Zone (http://www.guitarplayerzone.com) for great information on some of your favorite guitar brands
- ON! The Beginnings of Electric Sound Generation (http://www.museumofmakingmusic.org/index.php?option=com_content&task=view&id=206&Itemid=4) – an exhibit at the Museum of Making Music, National Association of Music Merchants, Carlsbad, CA – some of the earliest electric guitars and their history, from the collection of Lynn Wheelwright and others
- From Frying Pan to Flying V: The Rise of the Electric Guitar (http://invention.smithsonian.org/centerpieces/guitars/)
- "Born to Rock" guitar exhibit (http://www.borntorock.tv/) at Harrods, London, February 2007, featuring the 1931 Rickenbacker "Frying Pan". Also see BBC 6 Music
- news story. (http://www.bbc.co.uk/6music/news/20070202_borntorock.shtml)
- When to Change Electric, Acoustic, Bass and Classical Guitar Strings (http://www.guitarbitz.com/When_To_Change_Guitar_Strings.asp)
- Guide to Buying an Electric Guitar (http://www.guitarbitz.com/buyersguide.asp)
- The Invention of the Electric Guitar (http://invention.smithsonian.org/centerpieces/electricguitar/index.htm) – Online exhibition at the Smithsonian Institution's National Museum of American History

Koto (musical instrument)

The **koto** (箏) is a traditional Japanese stringed musical instrument, similar to the Chinese *guzheng*. The koto is the national instrument of Japan.[1] Koto are about 180 centimetres (71 in) width, and made from *kiri* wood (*Paulownia tomentosa*). They have 13 strings that are strung over 13 movable bridges along the width of the instrument. Players can adjust the string pitches by moving these bridges before playing, and use three finger picks (on thumb, index finger, and middle finger) to pluck the strings.


Japanese 13-stringed koto

Name

The character for *koto* is 箏, although 琴 is often used, but 琴 usually refers to another instrument, the kin. 箏, is also read as *sō* in certain contexts.

History

The ancestor of the koto (either the *se* or *zheng*) originated in its earliest form in the 5th century and was first introduced to Japan from China in the 7th and 8th century. The first known version had five strings, which eventually increased to seven strings. (It had twelve strings when it was introduced to Japan in the early Nara Period (710–784) and increased to thirteen strings). This particular instrument is known throughout Asia but in different forms: the Japanese koto, which is a distant relative to the Chinese *zheng*, the Korean *gayageum*, and the Vietnamese *dan tranh*. This variety of instrument came in two basic forms, a zither that had bridges and zithers without bridges. The type that was most known in China was the qin, similar in design to many other instruments in Asia.


An 1878 depiction by Settei Hasegawa of a woman playing the koto.

When the koto was first imported to Japan, the native word *koto* was a generic term for any and all Japanese stringed instruments. Over time the definition of *koto* could not describe the wide variety of these stringed instruments and so the meanings changed. The azumagoto or yamatogoto was called the wagon, the kin no koto was called the kin, and the sau no koto (sau being an older pronunciation of 箏) was called the sō or koto.

The modern koto originates from the gakusō used in Japanese court music. It was a popular instrument among the wealthy; the instrument koto was considered a romantic one. Some literary and historical records indicate that solo pieces for koto existed centuries before sōkyoku, the music of the solo koto genre, was established. According to Japanese literature, the koto was used as imagery and other extra music significance. In one part of "The Tales of Genji (Genji monogatari)", Genji falls deeply in love with a mysterious woman, who he has never seen before, after he hears her playing koto from a distance.

The history of the koto in Japan dates back to the 16th Century. At this time a Buddhist priest by the name of Kenjun (1547–1636), who lived in northern Kyūshū, began to compose for the koto, calling the style "tsukushi goto".

Perhaps the most important influence on the development of koto was Yatsuhashi Kengyo (1614–1685). He was a gifted blind musician from Kyoto who changed the limited selection of six songs to a brand new style of koto music which he called kumi uta. Yatsuhashi changed the Tsukushi goto tunings, which were based on gagaku ways of

tuning; and with this change, a new style of koto was born. Yatsuhashi Kengyo is now known as the "Father of Modern Koto".


Masayo Ishigure playing a 13-string koto

The Japanese developments in the bridgeless zithers include the one-stringed koto (*ichigenkin*) and two-stringed koto (nigenkin or yakumo goto) around the 1920s, Goro Morita created a new version of the two-stringed goto. On this goto, one would push down buttons above the metal strings like the western autoharp. It was named the taisho goto after the Taisho Era.

At the beginning of the Meiji Period (1868–1912), western music was introduced to Japan. Michio Miyagi (1894–1956), a blind composer, innovator, and performer, is considered to have been the first Japanese composer to combine western music and traditional koto music. Miyagi is largely regarded as being responsible for keeping the koto alive when traditional Japanese arts were being forgotten and replaced by Westernization. He wrote over 300 new works for the instrument before his death in a train accident at the age of 62. He also invented the popular 17 string bass koto, created new playing techniques, advanced traditional forms, and most importantly increased the koto's popularity. He performed abroad and by 1928 his piece for koto and shakuhachi, *Haru no Umi* (Spring Sea) had been transcribed for numerous instruments. Haru no Umi is even played to welcome each New Year in Japan.

Since Miyagi's time, many composers such as Tadao Sawai (1937–1997) have written and performed works that continue to advance the instrument. Sawai's widow Kazue Sawai, who as a child was Miyagi's favored disciple, has been the largest driving force behind the internationalization and modernization of the koto. Her arrangement of composer John Cage's prepared piano duet "Three Dances" for four prepared bass koto was a landmark in the modern era of koto music.

Construction


Detail of koto

A koto is typically made of Paulownia wood. The treatment of the wood before making the koto varies tremendously: one koto maker seasons the wood for perhaps a year on the roof of the house. Some wood may have very little treatment. Kotos may or may not be adorned, some adornments include inlays of ivory and ebony, tortoise shell, metal figures, etc.

The bridges (ji) used to be made of ivory, but nowadays are typically made of plastic, and occasionally made of wood. For some very low notes, there are small bridges made, as well as specialty bridges with three different heights, depending on the need of the tuning. When a small bridge is unavailable for some very low notes, some players may, as an emergency measure, use a bridge upside down. Of course, such an arrangement is unstable, and the bridge would have a tendency to fall down. Bridges have been known to break during playing, and with some older instruments which have the surface where the bridges rest being worn due to much use, the bridges may fall during playing, especially when pressing strings. There are, of course, various sorts of patch materials sold to fill the holes which cause the legs of a bridge to rest on an unstable area.

Ji(bridge)

The strings are made from a variety of materials. Various types of plastic strings are popular. Silk strings are still made. Silk strings are usually yellow in color, but they cost more and are not as durable, but claimed to be more musical. The strings are tied with a half hitch to a roll of paper or cardboard, about the size of a cigarette butt, strung through the holes at the head of the koto, threaded through the holes at the back, tightened, and tied with a special knot. Strings can be tightened by a special machine, but often are tightened by hand, and then tied. One can tighten by pulling the string from behind, or sitting at the side of the koto, although the latter is much harder and requires much arm strength. Some instruments may have tuning pins (like a piano) installed, to make tuning easier.

Koto today

Koto concert at Himejijo kangetsukai in 2009

The influence of Western pop music has made the koto less prominent in Japan, although it is still developing as an instrument. The 17-string bass koto, called *jūshichi-gen* in Japanese, has become more prominent over the years since its development by Michio Miyagi. There are also 20-string, 21-string, and 25-string kotos. Works are being written for 20- and 25-stringed kotos and 17-string bass kotos, and a new generation of players such as Japanese master Kazue Sawai, her students including Michiyo Yagi, and American performer Reiko Obata, are finding places for the koto in today's jazz, experimental music and even pop. The members of the band Rin' are popular *jūshichi-gen* players in the modern (pop/rock) music scene.

Michiyo Yagi playing a 21-string koto

Well-known solo performers outside of Japan include koto master and award-winning recording artist Elizabeth Falconer, who also studied for a decade at the esteemed Sawai Koto School in Tokyo, as well as koto master Linda Kako Caplan, Canadian daishihan (grandmaster) and a member of Fukuoka's Chikushi Koto School for over two decades. Yukiko Matsuyama leads her KotoYuki band in Los Angeles. Her compositions blend the timbres of World Music with her native Japanese culture. Another Sawai disciple, Masayo Ishigure, holds down a school in New York City.

In March, 2010 the koto received widespread international attention when a video linked by the Grammy Award-winning hard rock band Tool on its website became a viral hit. The video showed Tokyo-based ensemble Soemon playing member Brett Larner's arrangement of the Tool song "Lateralus" for six koto and two bass koto. Larner had previously played koto with John Fahey, Jim O'Rourke and members of indie rock groups including Camper Van Beethoven, Deerhoof, Jackie O Motherfucker and Mr. Bungle.

In older pop and rock music, David Bowie used a koto in the instrumental piece "Moss Garden" on his album *"Heroes"*. The brilliant multi-instrumentalist, founder and former The Rolling Stones guitarist Brian Jones played koto in the song Take It Or Leave, on the album Aftermath, 1966. Paul Gilbert, a popular guitar virtuosoist, recorded his wife, Emi playing the koto on his song "Koto Girl" from the album *Alligator Farm*. Visual Kei band Kagrra, are

well known for using traditional Japanese musical instruments in many of their songs, an example being "Utakata" (うたかた), a song in which the koto has a prominent place. Winston Tong, singer with Tuxedomoon, uses it on his 15-minute song, "The Hunger" from his debut solo album Theoretically Chinese. The rock band Queen used a (toy) koto in "The Prophet's Song" on their 1975 album *A Night at the Opera*. Dr. Dre's 1999 album Chronic 2001 prominently features a synthesized koto on two of its tracks - "Still D.R.E." and "The Message". David Horvitz played the instrument in a contemporary indie rock scene setting on Xiu Xiu's album, *The Air Force*.

The influence of the koto on Western music is also evident in jazz. The "in-sen" scale, a five note scale, was first introduced to jazz by John Coltrane and McCoy Tyner (another koto player) and is based on the tuning of the koto. Jazz pianist Dave Brubeck composed "Koto Song" that, while not featuring the koto itself, is played to allow the piano to emulate its sound. June Kuramoto of the jazz fusion group Hiroshima was one of the first koto performers to popularize the koto in a non-traditional fusion style. Reiko Obata, founder of East West Jazz band, is the first to perform and record an album of jazz standards featuring koto. Obata also produced the first-ever English language koto instructional DVD "You Can Play Koto". Brett Larner was also active in jazz, recording a duo CD with saxophone legend and composer Anthony Braxton.

Bibliography

- The Koto: A Traditional Instrument in Contemporary Japan [2], by Henry Johnson (Hotei, 2004)
- The Kumiuta and Danmono Traditions of Japanese Koto Music, by Willem Adriaansz (University of California Press, 1973)

Recordings

- **Silenziosa Luna -** 沈□の月 / ALM Records ALCD-76 (2008)

References

- Johnson, H. (2004). The Koto: A Traditional Instrument in Contemporary Japan [2]. Amsterdam: Hotei.
- Malm, W. P. (2000) Traditional Japanese Music and Musical Instruments (Rev. ed.). New York, NY: Kodansha International.
- Sachs, C. (1940). The History of Musical Instruments. New York, NY: W.W. Norton & Company. Inc. Publishers.
- Richard Louis Edmonds, et al. "Japan". Grove Art Online. Oxford Art Online. July 30, 2008. [3]

[1] "Koto" (http://www.britannica.com/ebc/article-9369409). Encyclopedia Britannica Online. . Retrieved 2008-03-18.

[2] http://www.brill.nl/default.aspx?partid=18&pid=26504

[3] http://www.oxfordartonline.com.ezproxy.umuc.edu/subscriber/article/grove/art/T043440pg38

External links

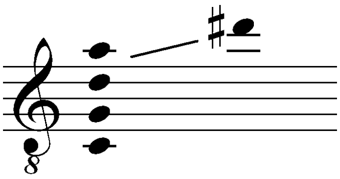
- Koto, early 17th century, Japan (http://www.metmuseum.org/toah/hd/edop/ho_2007.194a-f.htm) at The Metropolitan Museum of Art
- Koto no Koto (http://www.kotonokoto.org/) - Koto no koto: the website with general information

Banjo

Banjo

A modern 5-string banjo

String instrument	
Hornbostel-Sachs classification	321.322-5 (Composite chordophone sounded by the bare fingers)
Developed	18th century
Playing range	



(a standard tuned four-string banjo)

The **banjo** is a stringed instrument with, typically, four or five strings, which vibrate a membrane of plastic material or animal hide stretched over a circular frame. Simpler forms of the instrument were fashioned by enslaved Africans in Colonial America, adapted from several African instruments of the same basic design.[1]

The banjo is usually associated with country, folk, classical music, Irish traditional music and bluegrass music. Historically, the banjo occupied a central place in African traditional music, before becoming popular in the minstrel shows of the 19th century. In fact, blacks influenced early development of the music that became country and bluegrass, through the introduction of the banjo and through the innovation of musical techniques for both the banjo and fiddle.[2] [3] [4] The banjo, with the fiddle, is a mainstay of American old-time music.

Recently, the banjo has enjoyed inclusion in a wide variety of musical genres, including pop crossover music, indie rock and Celtic punk.

History

There are several theories concerning the origin of the name *banjo*. It may derive from the Kimbundu term *mbanza*. Some etymologists believe it comes from a dialectal pronunciation of the Portuguese "bandore" or from an early anglicisation of the Spanish word "bandurria", though other research suggests that it may come from a Senegambian term for a bamboo stick formerly used for the instrument's neck.

Various instruments are known in Africa with a skin head and gourd (or similar shell) body.[5] The African instruments differ from early Afro American banjos in that the necks do not possess a Western-style fingerboard and tuning pegs, instead having stick necks, with strings attached to the neck with loops for tuning.[5] Banjos with fingerboards and tuning pegs are known from the Caribbean as early as the 17th Century.[6] 18th and early 19th century writers transcribed the name of these instruments variously as "bangie", "banza", "banjer" and "banjar". Instruments similar to the banjo (e.g., the Japanese *shamisen*, Persian *tar* and Morroccan *sintir*) have been played in many countries. Another likely ancestor of the banjo is the *akonting*, a spike folk lute played by the Jola tribe of Senegambia, and the *ubaw-akwala* of the Igbo.[7] Similar instruments include the *xalam* of Senegal and the *ngoni* of the Wassoulou region including parts of Mali, Guinea, and the Ivory Coast as well as a larger variation of the ngoni developed in Moroccan by sub-Saharan Africans known as the Gimbri .

Early, African-influenced banjos were built around a gourd body and a wooden stick neck. These instruments had varying numbers of strings, though often including some form of drone. The five-string banjo was popularized by Joel Walker Sweeney, an American minstrel performer from Appomattox Court House, Virginia.[8]

Helmholtz notation

Note:	This article uses Helmholtz pitch notation to define banjo tunings.

In the 1830s Sweeney became the first white man to play the banjo on stage.[8] His version of the instrument replaced the gourd with a drum-like sound box and included four full-length strings alongside a short fifth-string. There is no proof, however, that Sweeney invented either innovation. This new banjo came to be tuned g'cgbd'. This is not quite a straight transposition of the e'aeg#b' tuning of the banjar; the B string of the banjo has the lowest pitch (a straight transposition would be g'c'gbd'.) Banjos were introduced in Britain by Sweeney's group, the American Virginia Minstrels, in the 1840s, and became very popular in music halls.[9]

The modern banjo

The modern banjo comes in a variety of forms, including four- and five-string versions. A six-string version, tuned and played similarly to a guitar, has gained popularity. In almost all of its forms, banjo playing is characterized by a fast arpeggiated plucking, though there are many different playing styles.

The body, or "pot", of a modern banjo typically consists of a circular rim (generally made of wood, though metal was also common on older banjos) and a tensioned head, similar to a drum head. Traditionally the head was made from animal skin, but today is often made of various synthetic materials. Most modern banjos also have a metal "tone ring" assembly that helps further clarify and project the sound, however many older banjos did not include a tone ring

The banjo is usually tuned with friction tuning pegs or planetary gear tuners, rather than the worm gear machine head used on guitars. Frets have become standard since the late 19th century, though fretless banjos are still manufactured and played by those wishing to execute glissando or otherwise achieve the sound and feeling of early playing styles.

Modern banjos are typically strung with metal strings. Usually the fourth string is wound with either steel or bronze-phosphor alloy. Some players may string their banjos with nylon or gut strings to achieve a more mellow, old-time tone.

Open-back and resonator

Some banjos have a separate resonator plate on the back of the pot, designed to project the sound forward and give the instrument more volume. This type of banjo is usually used in bluegrass music, though resonator banjos are played by players of all styles, and are also used in old-time as a substitute for electric amplification when playing in large venues.

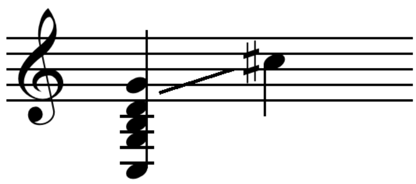
Open-back banjos generally have a mellower tone and weigh less than resonator banjos. They usually have a different setup than a resonator banjo, often with a higher string action (string action refers to how high the strings are positioned above the fingerboard.)

Five-string banjo

Typical Banjo.

The modern 5-string banjo is a variation on Sweeney's original design. The fifth string is usually the same gauge as the first, but starts from the fifth fret, three quarters the length of the other strings. (The long-necked Vega Pete Seeger model starts the fifth string from the eighth fret.) This lets the string be tuned to a higher open pitch than possible for the full-length strings. The short fifth string means that, unlike many string instruments, strings pitches on a five string banjo do not go in order from lowest to highest across the fingerboard. Instead, from low to high, they go fourth, third, second, first, and fifth. This is a form of reentrant tuning.

The short fifth string presents special problems for a capo. For small changes (going up or down one or two semitones, for example) it is possible simply to re-tune the fifth string. Otherwise, various devices called *fifth string capos* can effectively shorten the string. Many banjo players use model railroad spikes or titanium spikes (usually installed at the seventh fret and sometimes at others), that they hook the string under to press it down on the fret.



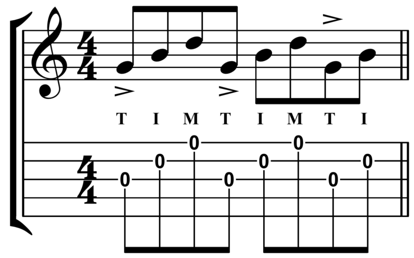
Range of five-string banjo tuned g'cgbd'.

Many tunings are used for the five-string banjo. Probably the most common, particularly in bluegrass, is the Open-G tuning g'dgbd'. In earlier times, the tuning g'cgbd' was commonly used instead. Other tunings found in old-time music include double C (g'cgc'd'), "sawmill" (g'dgc'd') also called "mountain modal" and open D (f#'df#ad'.) These tunings are often taken up a tone, either by tuning up or using a capo. For example "old-time D" tuning (a'dad'e') - commonly reached by tuning up from double C - is often played to accompany fiddle tunes in the key of D and Open-A (a'eac#'e') is usually used for playing tunes in the key of A.

While the size of the five string banjo is largely standardized, smaller and larger sizes are available including the long-neck or *Seeger neck* variation designed by Pete Seeger. Petite variations on the 5-string banjo have been available since the 1890s. S.S. Stewart introduced the banjeaurine, tuned one fourth above a standard five-string. Piccolo banjos are smaller, and tuned one octave above a standard banjo. Between these sizes and the standard there is the A-scale banjo, which is two frets shorter and usually tuned one full step above standard tunings. A "Stealth" brand banjo is a modern 5 string banjo with a 22.5" scale length, similar to a guitar.

A five-string banjo.

American old-time music typically uses the five-string open back banjo. It is played in a number of different styles, the most common being clawhammer or frailing, characterized by the use of a downward rather than upward motion when striking the strings with a fingernail. Frailing techniques use the thumb to catch the fifth string for a drone after each strum or twice in each action ("double thumbing"), or to pick out additional melody notes in what is known as "drop-thumb." Pete Seeger popularised a folk style by combining clawhammer with "up picking", usually without the use of fingerpicks. Another common style of old-time banjo playing is *Fingerpicking banjo* or *classic banjo*. This style is based upon parlor-style guitar.[10]



Forward roll[11] Play.

Bluegrass music, which uses the five-string resonator banjo almost exclusively, is played in several common styles. These include Scruggs style, named after Earl Scruggs; melodic, or Keith style, named for Bill Keith; and three-finger style with single string work, also called Reno style after Don Reno. In these styles the emphasis is on arpeggiated figures played in a continuous eighth-note rhythm, known as rolls. All of these styles are typically played with fingerpicks.

The five-string banjo has been used in classical music since before the turn of the 20th century. Contemporary and modern works have been written or arranged for the instrument by Buck Trent, Béla Fleck, Tony Trischka, Steve Martin, Tim Lake [12], George Crumb, Modest Mouse, Jo Kondo, Paul Elwood, Hans Werner Henze (notably in his Sixth Symphony), Daniel Mason of Hank Williams III's Damn Band, Beck, the Water Tower Bucket Boys, J.P. Pickens, Peggy Honeywell, Norfolk & Western, Putnam Smith, Iron & Wine, The Avett Brothers, and Sufjan Stevens.

The first 5-string electric solid-body banjo was developed by Charles (Buck) Wilburn Trent, Harold "Shot" Jackson, and David Jackson in 1960.

Four-string banjos

The **plectrum banjo** is a standard banjo without the short drone string. It usually has 22 frets on the neck and a scale length of 26 to 28 inches, and was originally tuned cgbd'. It can also be tuned like the top four strings of a guitar, which is known as "Chicago tuning." As the name suggests, it is usually played with a guitar-style pick (that is, a single one held between thumb and forefinger), unlike the five-string banjo, which is either played with a thumbpick and two fingerpicks, or with bare fingers. The plectrum banjo evolved out of the five-string banjo, to cater to styles of music involving strummed chords. The plectrum is also featured in many early jazz recordings and arrangements.

Plectrum banjo from Gold Tone

Cello banjo from Gold Tone

Four-string banjo

The shorter-necked, **tenor banjo** is also typically played with a plectrum. It became a popular instrument after about 1910. Early models used for melodic picking typically had 17 frets on the neck and a scale length of 19½ to 21½ inches. By the mid-1920s, when the instrument was used primarily for strummed chordal accompaniment, 19-fret necks with a scale length of 21¾ to 23 inches became standard. The usual tuning is cgd'a', like a viola or mandola, but some players (particularly in Irish traditional music) tune it Gdae′ like an octave mandolin, which lets the banjoist duplicate fiddle and mandolin fingering. The invention and/or popularisation of this tuning is usually attributed to Barney McKenna, banjoist with The Dubliners.

Irish tenor banjo from Gold Tone

The tenor banjo was a common rhythm instrument in early 20th-century dance bands. Its volume and timbre suited early jazz (and jazz-influenced popular music styles) and could both compete with other instruments (such as brass instruments and saxophones) and be heard clearly on acoustic recordings. George Gershwin's Rhapsody in Blue, in Ferde Grofe's original jazz orchestra arrangement, includes tenor banjo, with widely-spaced chords not easily playable on plectrum banjo in its conventional tuning(s). With development of the archtop and electric guitar, the tenor banjo largely disappeared from jazz and popular music, though keeping its place in traditional "Dixieland" jazz.

Rarer than either the tenor or plectrum banjo is the cello banjo. It's normally tuned CGda, one octave below the tenor banjo like the cello and mandocello. It played a role in banjo orchestras in the late nineteenth and early twentieth centuries. Bass banjos have been produced in both upright bass formats and with standard, horizontally-carried banjo bodies.

Four-string banjos, both plectrum and tenor, can be used strictly for chordal accompaniment (as in early jazz), strictly for single string melody playing (as in Irish traditional music), in "chord melody" style (a succession of chords are played in which the highest notes carry the melody), in tremolo style (both on chords and single strings) and a mixed technique called duo style, which combines single string tremolo and rhythm chords. Fingerstyle opportunities of tenor banjo retuned to open G tuning dgd'g' or lower open D tuning Adad' (three finger picking, frailing) are explored by Mirek Patek.

Eddie Peabody was the greatest proponent of the plectrum banjo in the early to mid twentieth century. Johnny Baier, Bill Lowrey, Steve Peterson, and Buddy Wachter are prominent contemporary four-string banjoists currently working professionally. Harry Reser, who also played plectrum banjo, was arguably the best tenor banjoist of the same era and wrote a large number of works for tenor banjo as well as instructional material. He was well known in the banjo player community up until his passing in 1965. His single string and "chord melody" technique and ability arguably set the "high mark" that many subsequent tenor players endeavor to attain. Other prominent professional tenor performers were Mike Pingitore and Roy Smeck. Smeck was an influential performer on many fretted instruments, including the four-string banjo. He also wrote a number of solos and instructional books. Prominent contemporary tenor players are Don Vappie, Ken Aoki, Steve Di Bonaventura, David Bandrowski, the late Narvin Kimball of Preservation Hall Jazz Band fame, and Charlie Tagawa. Tagawa has been the music director of the Peninsula Banjo Band, one of the most prominent banjo bands in the U.S., since 1966. He was a student and devotee of Harry Reser. In the United Kingdom, Frank Lawes was one of the most prolific composers of four string banjo

music.

The four-string banjo is used from time to time in musical theater. Examples include: Hello, Dolly!, Mame, Chicago, Cabaret, Oklahoma!, Half a Sixpence, Annie, Barnum, The Threepenny Opera, Monty Python's Spamalot, and countless others. Joe Raposo had used it variably. in the imaginative 7-piece orchestration for the long-running TV show Sesame Street, and has sometimes had it overdubbed with itself or an electric guitar. The banjo is still (albeit rarely) in use in the show's arrangement currently.

Six-string banjos

Old 6-string zither banjo

The 6-string banjo began as a British innovation by William Temlet, one of England's earliest banjo makers. He opened a shop in London in 1846, and sold banjos with closed backs and up to 7 strings. He marketed these as "zither" Banjos from his 1869 patent. American Alfred Davis Cammeyer (1862–1949), a young violinist-turned banjo concert player, devised the 5/6-string Zither banjo around 1880. It had a wood resonator and metal "wire" strings (the 1st and 2nd melody strings and 5th "thumb" string. The 3rd melody string was gut and the 4th was silk covered) as well as frets and guitar-style tuning machines.

A Zither banjo usually has a closed back and sides with the drum body (usually metal) and skin tensioning system suspended inside the wooden rim/back, the neck and string tailpiece was mounted on the wooden outer rim, the short string usually led through a tube in the neck so that the tuning peg could be mounted on the peg head. They were often made by builders who used guitar tuners that came in banks of three and so if 5 stringed had a redundant tuner. The banjos could also be somewhat easily converted over to a six string banjo. British opera diva Adelina Patti advised Cammeyer that the zither-banjo might be popular with English audiences (which was certainly true as it was invented there), and Cammeyer went to London in 1888. Due to his virtuoso playing he helped show that banjos could be used for more sophisticated music than was normally played by blackface minstrels, he was soon performing for London society, where he met Sir Arthur Sullivan, who recommended that Cammeyer progress from writing banjo arrangements of music to composing his own music. (Interesting to note that, supposedly unbeknownst to Cammeyer, William Temlett had patented a 7-string closed back banjo in 1869, and was already marketing it as a "zither-banjo.")

In the late 1890s Banjo maker F.C Wilkes developed a 6-string version of the banjo with the 6th string "tunnelled" through the neck. It is arguable that Arthur O. Windsor had much influence in creating and perfecting the Zither banjo and creating the open-back banjo[13] along with other modifications to the banjo type instruments, such as the non-solid attached resonator that banjos' today have (Gibson lays claim to this modification on the American Continent). Windsor claims to be the first in creating the hollow neck banjo with a truss rod, and he buried the 5th string in the neck after the 5th fret so to put the tuning peg on the peg-head rather than in the neck. Gibson lays claim to perfecting the banjo with the tone rings.

The six-string or banjitar was the instrument of the early jazz great Johnny St. Cyr, as well as of jazzmen Django Reinhardt, Danny Barker, Papa Charlie Jackson and Clancy Hayes, as well as the blues and gospel singer The Reverend Gary Davis. Nowadays, it sometimes appears under such names as guitanjo, guitjo, ganjo, banjitar, or bantar. Today, musicians as diverse as Keith Urban, Rod Stewart, Taj Mahal, Joe Satriani, David Hidalgo and Doc Watson play the 6-String banjo.

Rhythm guitarist Dave Day of 1960's proto-punks The Monks replaced his guitar with a six-string, gut-strung banjo on which he played guitar chords. This instrument sounds much more metallic, scratchy and wiry than a standard electric guitar, due to its amplification via a small microphone stuck inside the banjo's body.

Banjo hybrids and variants

A number of hybrid instruments exist, crossing the banjo with other stringed instruments. Most of these use the body of a banjo, often with a resonator, and the neck of the other instrument. Examples include the banjo mandolin, the Banjolin, and the banjo ukulele or banjolele, most famously played by the English comedian George Formby.[14] These were especially popular in the early decades of the twentieth century, and were probably a result of a desire either to allow players of other instruments to jump on the banjo bandwagon at the height of its popularity, or to get the natural amplification benefits of the banjo resonator in an age before electric amplification.

Instruments using the five-string banjo neck on a wooden body (for example, that of a bouzouki or resonator guitar) have also been made, such as the banjola. A 20th-Century Turkish instrument very similar to the banjo is called cümbüs.

References

[1] Bluegrass Music: The Roots (http://www.ibma.org/about.bluegrass/history/index.asp)." IBMA. Retrieved on 2006-08-25.

[2] Winship, David. "The African American Music Tradition in Country Music (http://www.birthplaceofcountrymusic.org/index.cgi?CONTEXT=cat&cat=10043)." BCMA, Birthplace of Country Music Alliance. Retrieved 02-08-2007. Archived (http://web.archive.org/20070204113038/http://www.birthplaceofcountrymusic.org/index.cgi?CONTEXT=cat&cat=10043) February 4, 2007 at the Wayback Machine..

[3] Conway, Cecelia (2005). *African Banjo Echoes in Appalachia*. The University of Tennessee Press. p. 424.

[4] "Old-time (oldtimey) Music What is it? (http://www.traditionalmusic.co.uk/whatisoldtime/old-time-music-definition.htm)." TML, A Traditional Music Library. Retrieved 02-08-2007.

[5] Pestcoe, Shlomoe and Adams, Greg C., *Banjo Roots Research: Exploring the Banjo's African American Origins & West African Heritage*, 2010. Essay can be found online at (http://www.myspace.com/banjoroots/blog).

[6] Pestcoe, Shlomoe and Adams, Greg C., *Banjo Roots Research: Exploring the Banjo's African American Origins & West African Heritage*, 2010.

Essay can be found online at (http://www.myspace.com/banjoroots/blog).

[7] Chambers, Douglas B. (2009). *Murder at Montpelier: Ibo Africans in Virginia* (http://books.google.com/books?id=vqpoxEl_0_4C&pg=PA180). Univ. Press of Mississippi. p. 180. ISBN 16-047-3246-6. .

[8] Metro Voloshin, *The Banjo, from Its Roots to the Ragtime Era: An Essay and Bibliography* Music Reference Services Quarterly, Vol. 6(3) 1998.

[9] Information on the banjo and development of the Zither-banjo (http://www.shlomomusic.com/zitherbanjo.htm).

[10] Trischka, Tony (1992). *Banjo Songbook*, p.20. ISBN 0825601975.

[11] Davis, Janet (2002). *[Mel Bay's] Back-Up Banjo*, p.54. ISBN 0786665254. Emphasis original.

[12] http://www.timlake.com

[13] http://www.zither-banjo.org/pages/windsornew.htm

[14] "George Formbys Little Strad banjolele up for sale" (http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/music/article4029395.ece). *The Times* (London). 2008-05-30. .

Further reading

Banjo history

- Conway, Cecelia (1995). *African Banjo Echoes in Appalachia: A Study of Folk Traditions*, University of Tennessee Press. Paper: ISBN 0-87049-893-2; cloth: ISBN 0-87049-892-4. A study of the influence of African Americans on banjo playing throughout U.S. history.
- Gura, Philip F. and James F. Bollman (1999). *America's Instrument: The Banjo in the Nineteenth Century*. The University of North Carolina Press. ISBN 0-8078-2484-4. The definitive history of the banjo, focusing on the instrument's development in the 1800s.
- Katonah Museum of Art (2003). *The Birth of the Banjo*. Katonah Museum of Art, Katonah, New York. ISBN 0-915171-64-3.
- Linn, Karen (1994). *That Half-Barbaric Twang: The Banjo in American Popular Culture.* University of Illinois Press. ISBN 0-252-06433-X. Scholarly cultural history of the banjo, focusing on how its image has evolved over

the years.
- Tsumura, Akira (1984). *Banjos: The Tsumura Collection*. Kodansha International Ltd. ISBN 0-87011-605-3. An illustrated history of the banjo featuring the world's premier collection.
- Webb, Robert Lloyd (1996). *Ring the Banjar!*. 2nd edition. Centerstream Publishing. ISBN 1-57424-016-1. A short history of the banjo, with pictures from an exhibition at the MIT Museum.

External links

- Frailing banjo instruction (http://dailyfrail.com)
- Old-Time Banjo Music from Rural America (http://www.banjofrailer.com)
- *To Hear Your Banjo Play* (http://www.archive.org/details/to_hear_your_banjo_play), 1947 Alan Lomax film (16 minutes)
- *Old Time Banjo* (e-book) by Patrick Costello (http://www.archive.org/details/Old_time_banjo)
- Fingerstyle Tenor Banjo (http://www.mirekpatek.com)
- Tony Trischka School of Banjo (TTSB) (http://www.tonytrischkaschoolofbanjo.com/)
- Banjo Newsletter (http://www.banjonews.com/)
- Banjo Hangout (http://www.banjohangout.org/)
- Free Windows application with chord charts for banjo (http://www.tomkysoft.com/)
- Online, Open-Source Banjo Chord Generator (http://tpn.lowtech.org/banjo.php)
- Dr Joan Dickerson, Sparky Rucker, and George Gibson with host Michael Johnathon explore the *African-American History of the Banjo* through conversation and music on show 350 of the WoodSongs Old-Time Radio Hour. Both audio and video are provided (http://www.woodsongs.com/showlist.asp).

Ukulele

Martin 3K Professional Ukulele

String instrument	
Classification	String instrument (plucked, nylon stringed instrument usually played with the bare thumb and/or fingertips, or a felt pick.)
Hornbostel-Sachs classification	321.322 (Composite chordophone)
Developed	19th century
Related instruments	
• Bowed and plucked string instruments, in particular the cavaquinho	

The **ukulele**, (/ˌjuːkəˈleɪliː/ *ew-kə-**lay**-lee*;[1] from Hawaiian: *ʻukulele* Hawaiian pronunciation: [ˈʔukuˈlɛlɛ]; variantly spelled **ukelele** in the UK), sometimes abbreviated to **uke**, is a chordophone classified as a plucked lute; it is a subset of the guitar family of instruments, generally with four nylon or gut strings or four courses of strings.[2]

The ukulele originated in the 19th century as a Hawaiian interpretation of the cavaquinho or braguinha and the rajão, small guitar-like instruments taken to Hawaiʻi by Portuguese immigrants.[3] It gained great popularity elsewhere in the United States during the early 20th century, and from there spread internationally.

The tone and volume of the instrument varies with size and construction. Ukuleles commonly come in four sizes: soprano, concert, tenor, and baritone.

History

Hawaii

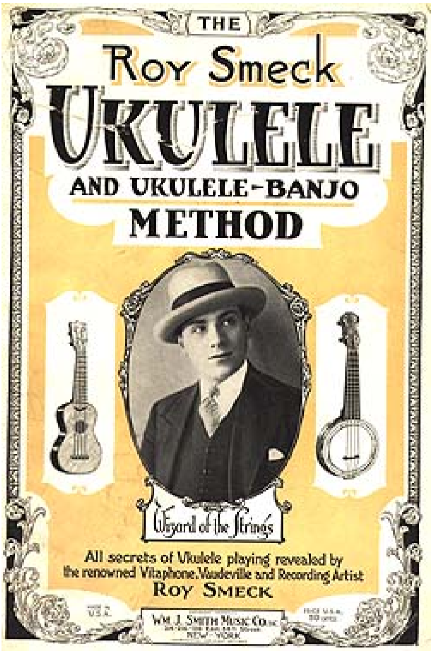
Ukuleles are commonly associated with music from Hawaii where the name roughly translates as "jumping flea",[4] perhaps due to the action of one's fingers playing the ukulele resembling a "jumping flea". According to Queen Lili'uokalani, the last Hawaiian monarch, the name means “the gift that came here”, from the Hawaiian words *uku* (gift or reward) and *lele* (to come). Developed in the 1880s, the ukulele is based on two small guitar-like instruments of Portuguese origin, the cavaquinho and the rajão, introduced to the Hawaiian Islands by Portuguese immigrants from Madeira and Cape Verde.[5] Three immigrants in particular, Madeiran cabinet makers Manuel Nunes, José do Espírito Santo, and Augusto Dias, are generally credited as the first ukulele makers.[6] Two weeks after they landed aboard the *Ravenscrag* in late August 1879, the *Hawaiian Gazette* reported that "Madeira Islanders recently arrived here, have been delighting the people with nightly street concerts."[7]

One of the most important factors in establishing the ukulele in Hawaiian music and culture was the ardent support and promotion of the instrument by King David Kalakaua. A patron of the arts, he incorporated it into performances at royal gatherings.[8]

U.S. mainland

Pre–World War II

The ukulele was popularized for a stateside audience during the Panama Pacific International Exposition, held from spring to fall of 1915 in San Francisco.[9] The Hawaiian Pavilion featured a guitar and ukulele ensemble, George E. K. Awai and his Royal Hawaiian Quartet,[10] along with ukulele maker and player Jonah Kumalae.[11] The popularity of the ensemble with visitors launched a fad for Hawaiian-themed songs among Tin Pan Alley songwriters.[12] The ensemble also introduced both the lap steel guitar and the ukulele into U.S. mainland popular music,[13] where it was taken up by vaudeville performers such as Roy Smeck and Cliff "Ukulele Ike" Edwards. On April 15, 1923 at the Rivoli Theater in New York City, Smeck appeared, playing the ukulele, in *Stringed Harmony*, a short film made in the DeForest Phonofilm sound-on film process. On August 6, 1926, Smeck appeared playing the ukulele in a short film *His Pastimes*, made in the Vitaphone sound-on-disc process, shown with the feature film *Don Juan* starring John Barrymore.[14]



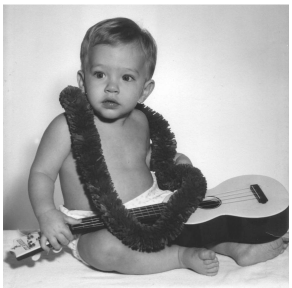
Cover of a 1928 instructional book for the ukulele by Roy Smeck, the "Wizard of the Strings"

The ukulele soon became an icon of the Jazz Age.[15] Highly portable and relatively inexpensive, it also proved popular with amateur players throughout the 1920s, as is evidenced by the introduction of uke chord tablature into the published sheet music for popular songs of the time,[15] a role that would eventually be supplanted by the guitar in the early years of rock and roll.[16] A number of mainland-based instrument manufacturers, among them Regal, Harmony, and Martin, added ukulele, banjolele, and tiple lines to their production to take advantage of the demand.

Opening title for the short Vitaphone film *His Pastimes* (1926)

Post–World War II

From the late 1940s to the late 1960s, plastics manufacturer Mario Maccaferri turned out about 9 million inexpensive ukuleles.[17] Much of the instrument's popularity was cultivated via *The Arthur Godfrey Show* on television.[18] Singer-musician Tiny Tim became closely associated with the instrument after playing it on his 1968 hit "Tiptoe Through the Tulips".



Boy in Hawaii wearing lei and holding a Maccaferri "Islander" plastic ukulele

Post-1990 Revival

After the 1960s, the ukulele declined in popularity until the late 1990s, when interest in the instrument reappeared.[19] During the 1990s, new manufacturers began producing ukuleles and a new generation of musicians took up the instrument.

Hawaiian musician Israel Kamakawiwo'ole helped popularise the instrument, in particular due to his 1993 ukulele medley of "Over the Rainbow" and "What a Wonderful World", used in several films, television programs, and commercials. The song reached #12 on *Billboard*'s Hot Digital Tracks chart the week of January 31, 2004 (for the survey week ending January 18, 2004).

a modern red ukulele

World

- **Japan**: The ukulele came to Japan in 1929 after Hawaiian-born Yukihiko Haida returned to the country upon his father's death and introduced the instrument. Haida and his brother Katsuhiko formed the Moana Glee Club, enjoying rapid success in an environment of growing enthusiasm for Western popular music, particularly Hawaiian music and jazz. During World War II, authorities banned most Western music, but fans and players kept it alive in secret, and it resumed popularity after the war. In 1959, Haida founded the Nihon Ukulele Association. Today, Japan is considered a second home for Hawaiian musicians and ukulele virtuosos.[20]
- **Canada**: In the 1960s, educator J. Chalmers Doane dramatically changed school music programmes across Canada, using the ukulele as an inexpensive and practical teaching instrument to foster musical literacy in the classroom.[21] There were 50,000 schoolchildren and adults learning ukulele through the Doane program at its peak.[22]
- **UK**: The singer and comedian George Formby was perhaps the most famous ukulele player in the UK, although this is technically a misnomer as what he actually played was a banjolele, a hybrid instrument consisting of an extended ukulele neck with a banjo resonator body. There has been a recent upsurge in demand for the instrument, due to its relative simplicity and portability.[23]

Types and tunings

Construction

Soprano pineapple ukulele, Baritone ukulele and taropatch baritone ukulele.

Ukuleles are generally made of wood, although variants have been made composed partially or entirely of plastic. Cheaper ukuleles are generally made from ply or laminate woods, in some cases with a soundboard of an inexpensive but acoustically superior wood such as spruce. Other more expensive ukuleles are made of solid hardwoods such as mahogany (*Swietenia* spp.). Some of the most expensive ukuleles, which may cost thousands of dollars, are made from koa (*Acacia koa*), a Hawaiian wood.

Typically ukuleles have a figure-eight body shape similar to that of a small acoustic guitar. They are also often seen in non-standard shapes, such as cutaway shape and an oval, usually called a "pineapple" ukulele, invented by the Kamaka ukulele company, or a boat-paddle shape, and occasionally a square shape, often made out of an old wooden cigar box.

Ukuleles "hanging out" in a music store.

These instruments may have just four strings; or some strings may be paired in courses, giving the instrument a total of eight strings.

Instruments with 8 strings in 4 courses are usually called taropatch ukuleles, and used to be common in a concert size, but now the tenor size is more common for taropatch ukuleles. There is also a 6 string, 4 course version, with 2 single and 2 double courses, called a Lili'u ukulele.[24]

Sizes

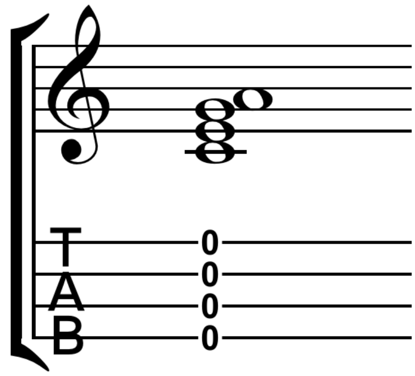
Four sizes of ukuleles are common: soprano, concert, tenor, and baritone. There are also less common sopranino and bass ukuleles at the extreme ends of the size spectrum.

The soprano, often called "standard" in Hawaii, is the smallest, and the original size ukulele. The concert size was developed in the 1920s as an enhanced soprano, slightly larger and louder with a deeper tone. Shortly thereafter, the tenor was created, having more volume and deeper bass tone. The largest common size is the baritone, created in the 1940s.

Type	Scale length[25]	Total length	Tuning[26] (Helmholtz notation)
soprano or standard	13" (33 cm)	21" (53 cm)	g'c'e'a' or a'd'f#'b'
concert	15" (38 cm)	23" (58 cm)	g'c'e'a' or gc'e'a'
tenor	17" (43 cm)	26" (66 cm)	gc'e'a', g'c'e'a', or d'gbe'
baritone	19" (48 cm)	30" (76 cm)	dgbe'

Tuning

The standard tuning for soprano, concert, and tenor ukuleles is C-tuning, g'c'e'a'. The g string is tuned an octave higher than might be expected. This is known as reentrant tuning. Some prefer "Low G" tuning, with the G in sequence an octave lower. The baritone is usually tuned to d g b e' (low to high).



Ukulele standard tuning Play.

Another common tuning for sopranos and concerts is D-tuning, a' d' f#' b', one step higher than the g'c'e'a' tuning. D tuning is said by some to bring out a sweeter tone in some ukuleles, generally smaller ones. This tuning was commonly used during the Hawaiian music boom of the early 20th century, and is often seen in sheet music from this period. D tuning with a low 4th, ad'f#'b' is sometimes called "Canadian tuning" after its use in the Canadian school system, mostly on concert or tenor ukes.

Hawaiian ukuleles may also be tuned to open tunings, similar to the Hawaiian slack key style.[27]

Related instruments

Ukulele varieties include hybrid instruments such as the guitalele (also called guitarlele), banjo ukulele, harp ukulele, and lap steel ukulele. There is an electrically amplified version, the electric ukulele. The resonator ukulele is louder and of different tone quality from traditional wooden ukuleles, producing sound by one or more spun aluminum cones (resonators) instead of the wooden soundboard. The Tahitian ukulele, another variant, is usually carved from a single piece of wood and does not have a hollow soundbox.

Close cousins of the ukulele include the Portuguese forerunners, the *cavaquinho* (also commonly known as *machete* or *braguinha*) and the slightly larger *rajão*. Other stringed variants include the Puerto Rican *bordonua*, the Venezuelan cuatro, the Colombian *tiple*, the *timple* of the Canary Islands, the Spanish *vihuela*, and the Andean *charango* traditionally made of an armadillo shell. In Indonesia, a similar Portuguese-inspired instrument is the kroncong.

Notes

[1] " ukulele (http://oed.com/search?searchType=dictionary&q=ukulele)". *Oxford English Dictionary*. Oxford University Press. 2nd ed. 1989.

[2] Erich M. von Hornbostel & Curt Sachs, "Classification of Musical Instruments: Translated from the Original German by Anthony Baines and Klaus P. Wachsmann." *The Galpin Society Journal* 14, 1961: 3-29.

[3] Norden, Ernest E.. "Portuguese Americans" (http://www.everyculture.com/multi/Pa-Sp/Portuguese-Americans.html). Multicultural America. . Retrieved 2009-02-23.

[4] Beloff 2003, p. 13

[5] Nidel, Richard (2004). *World Music: The Basics*. Routledge. p. 312. ISBN 9780415968003.

[6] Roberts, Helen (1926). *Ancient Hawaiian Music*. Bernice P. Bishop Museum. pp. 9–10.

[7] King, John (2000). "Prolegomena to a History of the ʻUkelele" (http://www.ukuleleguild.org/history.php). Ukulele Guild of Hawai'i. . Retrieved 2008-06-11.

[8] "David Kalakaua (1836–1891), Inaugural Hall of Fame Inductee, 1997" (http://ukulele.org/?Inductees:1997-1998:David_Kalakaua). Ukulele Hall of Fame Museum. 2008. . Retrieved 2008-06-11.

[9] Lipsky, William (2005). *San Francisco's Panama-Pacific International Exposition*. Arcadia Publishing. p. 36. ISBN 9780738530093.

[10] Doyle, Peter (2005). *Echo and Reverb: Fabricating Space in Popular Music Recording, 1900–1960*. Wesleyan. p. 120. ISBN 9780819567949.

[11] "Jonah Kumalae (1875–1940), 2002 Hall of Fame Inductee" (http://www.ukulele.org/?Inductees:2002-2003:Jonah_Kumalae). Ukulele Hall of Fame Museum. 2007. . Retrieved 2008-06-02.

[12] Koskoff, Ellen (2005). *Music Cultures in the United States: An Introduction*. Routledge. p. 129. ISBN 9780415965880.

[13] Volk, Andy (2003). *Lap Steel Guitar*. Centerstream Publications. p. 6. ISBN 9781574241341.

[14] Whitcomb, Ian (2000). *Ukulele Heaven: Songs from the Golden Age of the Ukulele*. Mel Bay Publications. p. 11. ISBN 9780786649518.

[15] Whitcomb, Ian (2001). *Uke Ballads: A Treasury of Twenty-five Love Songs Old and New*. Mel Bay Publications. p. 4. ISBN 9780786613601.
[16] Sanjek, Russell (1988). *American Popular Music and Its Business: The First Four Hundred Years*. Oxford University Press. p. 95. ISBN 0195043111.
[17] Wright, Michael (3 March 2002). "Maccaferri History: The Guitars of Mario Maccaferri" (http://www.vguitar.com/features/brands/details.asp?AID=1071). Vintage Guitar. . Retrieved 2008-06-02.
[18] "Arthur Godfrey (1903–1983), 2001 Hall of Fame Inductee" (http://www.ukulele.org/?Inductees:2000-2001:Arthur_Godfrey). Ukulele Hall of Fame Museum. 2007. . Retrieved 2008-06-02.
[19] John Shepherd (27 February 2003). *Continuum encyclopedia of popular music of the world: VolumeII: Performance and production* (http://books.google.com/books?id=pJvzEzjahkQC&pg=PA450). Continuum International Publishing Group. pp. 450–. ISBN 9780826463227. . Retrieved 16 April 2011.
[20] Beloff, Jim (2003). *The Ukulele: A Visual History*. Backbeat books. p. 110. ISBN 9780879307585.
[21] Karr, Gary, and McMillan, Barclay (1992). "J. Chalmers Doane" (http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=U1ARTU0000986). *Encyclopedia of Music in Canada*. University of Toronto Press. . Retrieved 2008-06-09.
[22] Beloff, Jim (2003). *The Ukulele: A Visual History*. Backbeat books. p. 111. ISBN 9780879307585.
[23] Fladmark, Judy (2010-02-19). "Ukulele sends UK crazy" (http://news.bbc.co.uk/2/hi/uk_news/magazine/8523082.stm). BBC News. .
[24] http://stringedinstrumentdatabase.110mb.com/u.htm
[25] The "Scale" is the length of the playable part of the strings, from the nut at the top to the bridge at the bottom.
[26] On the soprano, concert, and tenor instruments, the most common tuning results in a "bottom" string that is not the lowest, as it is tuned a 5th higher than the next string (and a Major 2nd below the "top" string).
[27] Kimura, Heeday. *How to Play Slack Key Ukulule*.

References

- Beloff, Jim (2003) [1997]. *The Ukulele: A Visual History* (Revised & Expanded ed.). San Francisco: Backbeat Books. ISBN 0-87930-758-7.

External links

- Live Ukulele (http://liveukulele.com/) – tabs, lessons, and reviews
- Tiki King's Ukulele Brand name database (http://www.tikiking.com/uke_database.html) – information on over 500 ukulele makers past and present

Harpsichord

A **harpsichord** is a musical instrument played by means of a keyboard. It produces sound by plucking a string when a key is pressed.


Harpsichord in the Flemish style

In the narrow sense, "harpsichord" designates only the large wing-shaped instruments in which the strings are perpendicular to the keyboard. In a broader sense, "harpsichord" designates the whole family of similar plucked keyboard instruments, including the smaller virginals, muselar, and spinet.

The harpsichord was widely used in Renaissance and Baroque music. During the late 18th century it gradually disappeared from the musical scene with the rise of the piano. But in the 20th century it made a resurgence, used in historically informed performance of older music, in new (contemporary) compositions, and in popular culture.

Mechanism

Harpsichords vary in size and shape, but they all have the same basic functional arrangement. The player depresses a key pivoted in the middle of its length, which causes the far end of the key to rise. This lifts a jack, a long strip of wood, to which is attached a small plectrum (a wedge-shaped piece of quill or, nowadays plastic), which plucks the string. When the key is released by the player, the far end returns to its rest position and the jack falls back. The plectrum, mounted on a tongue that can swivel backwards away from the string, passes the string without plucking it again. As the key reaches its rest position, the string's vibrations are halted by the damper, a piece of felt attached to the top of the jack.

These basic principles are explained in more detail below.

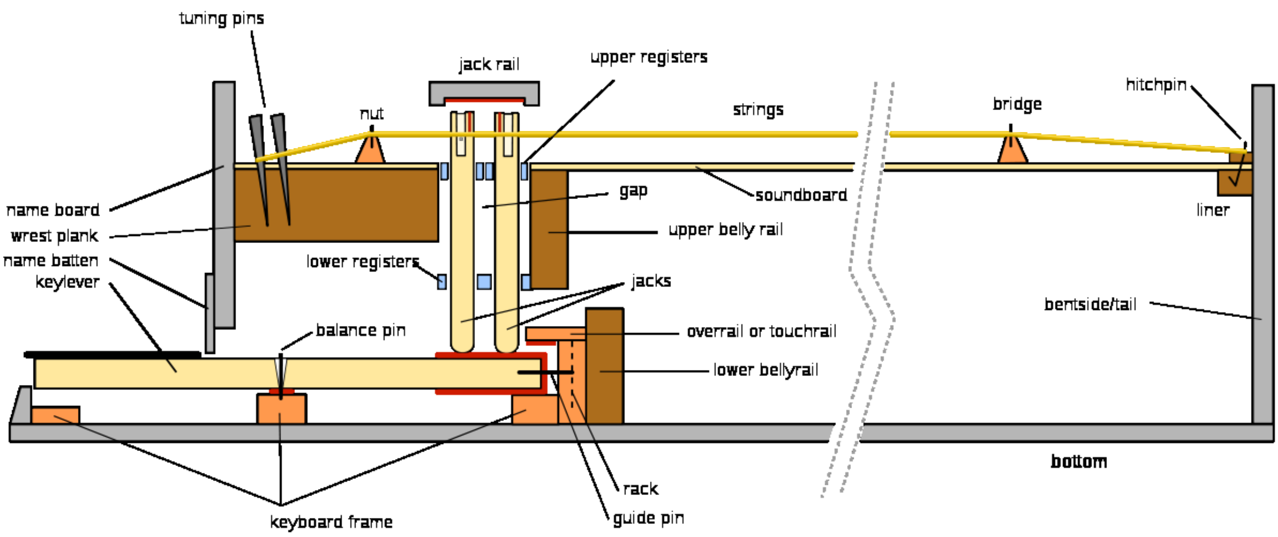


Figure 1. Schematic view of a 2 × 8' single manual harpsichord

- The *keylever* is a simple pivot, which rocks on a *balance pin* passing through a hole drilled through it.
- The *jack* is a thin, rectangular piece of wood which sits upright on the end of the keylever, held in place by the registers (the upper movable, the lower fixed) which are two long strips of wood running in the gap from spine to cheek with rectangular mortises through which the jacks can move up and down.

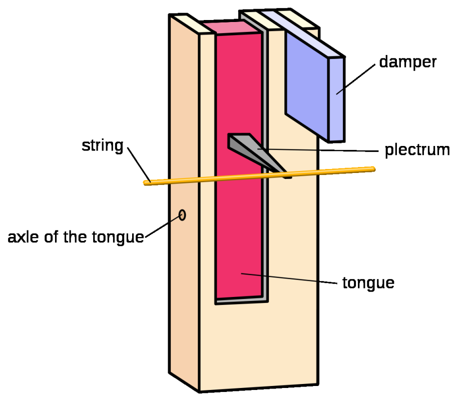


Figure 2. Upper part of a jack

- In the jack, a *plectrum* juts out almost horizontally (normally the plectrum is angled upwards a tiny amount) and passes just under the string. Historically, plectra were normally made of crow quill or leather; most modern harpsichords based on historic instruments have plastic (delrin or celcon) plectra.
- When the front of the key is pressed, the back of the key rises, the jack is lifted, and the plectrum plucks the string.

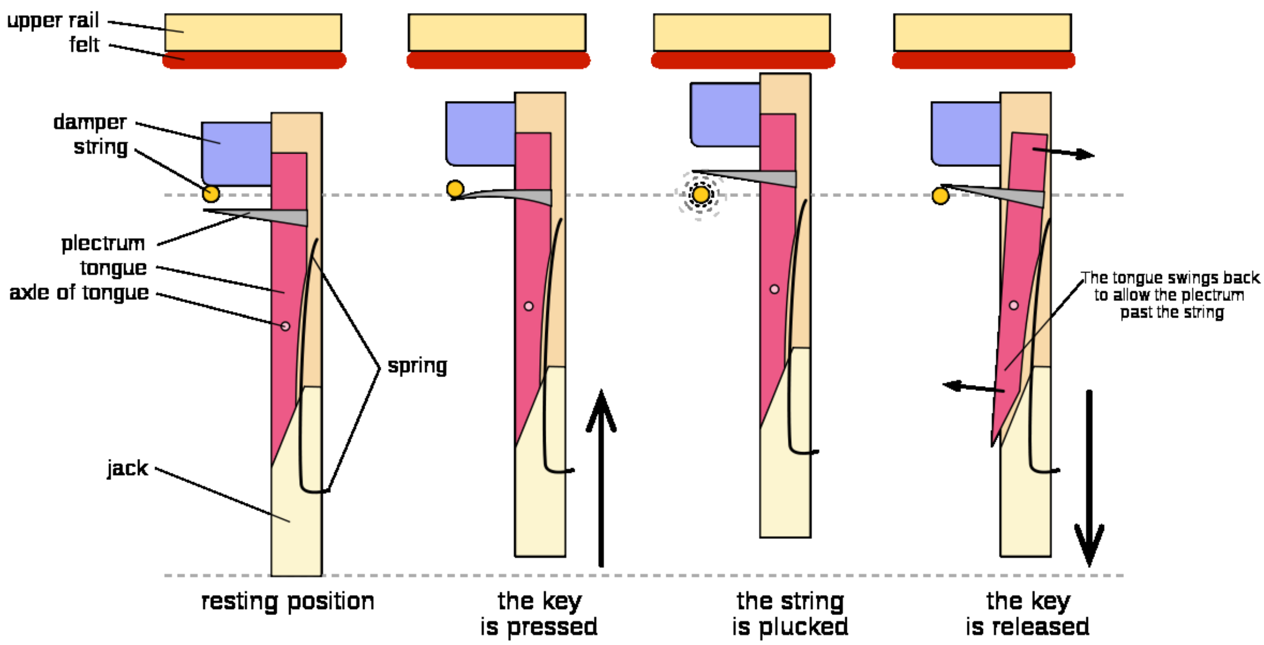


Figure 3. When the key is pressed, the jack is raised, and the plectrum touches the string and begins to bend. Then the plectrum plucks the string and causes it to sound. The jack hits the jack rail. When the player's hand is released from the key, the jack falls back down under its own weight, and the plectrum pivots backwards to allow it to pass the string.

- When the key is released, the jack falls back down under its own weight, and the plectrum pivots backwards to allow it to pass the string. This is made possible by having the plectrum held in a tongue which is attached with a pivot and a spring to the body of the jack.
- At the top of the jack, the felt damper keeps the string from vibrating when the key is not depressed.
- The vertical rise of the jacks is stopped by the jackrail, which is covered with soft felt to muffle the impact of the jack.

Strings, tuning, and soundboard

Each string is wound around a *tuning pin*, normally at the end of the string which is closer to the player. When rotated with a wrench or tuning hammer, the tuning pin adjusts the tension so that the string will sound the correct pitch. Tuning pins are held tightly in holes drilled in the *pinblock* or *wrestplank*, an oblong hardwood plank.

Proceeding from the tuning pin, a string next passes over the *nut*, a sharp edge that is made of hardwood and is normally attached to the wrestplank. The section of the string beyond the nut forms its *vibrating length*, which is plucked and creates sound.

At the other end of its vibrating length, the string passes over the bridge, another sharp edge made of hardwood. As with the nut, the horizontal position of the string along the bridge is determined by a vertical metal pin inserted into the bridge, against which the string rests.

The bridge itself rests on a *soundboard*, a thin panel of wood usually made of spruce, fir or—in some Italian harpsichords—cypress. The soundboard efficiently transduces the vibrations of the strings into vibrations in the air; without a soundboard, the strings would produce only a very feeble sound.

A string is attached at its far end by a loop to a *hitchpin* which secures it to the case.

Multiple choirs of strings

Many harpsichords have exactly one string per note. There are several reasons why it is sometimes an advantage to have more. When there are two choirs of strings at the same length, it is possible to arrange for them to give different tonal qualities, and thus to increase the variety of sound produced by the instrument. This is done by having one set of strings plucked closer to the nut, which emphasizes the higher harmonics, and produces a "nasal" sound quality. When two strings tuned to be the same pitch, or to an octave apart, are plucked simultaneously by a single keystroke, the note is louder and richer than one produced by a single string. The qualitative distinction is particularly noticeable when the strings are tuned an octave apart.

When describing a harpsichord it is customary to specify its choirs of strings, often called its disposition. Strings at eight foot pitch sound at the normal expected pitch, strings at four foot pitch sound an octave higher, and sometimes harpsichords have the rare 16-foot pitch (one octave lower than eight-foot) or two-foot pitch (two octaves higher).

When there are multiple choirs of strings, the player is often able to control which choirs sound. This is usually done by having a set of jacks for each choir, and a mechanism for "turning off" each set, often by moving the upper register (through which the jacks slide) sideways a short distance, so that their plectra miss the strings. In simpler instruments this is done by manually moving the registers, but as the harpsichord evolved, builders invented levers, knee levers and pedal mechanisms to make it easier to change registration.

More flexibility in selecting which strings play is available in harpsichords having more than one keyboard or manual, since each manual can control the plucking of a different set of strings. In addition, such harpsichords often have a mechanism to couple manuals together, so that two can be used while actually playing on only one. The most flexible system is the French shove coupler, in which the lower manual can slide forward and backward, so that in the backward position "dogs" attached to the upper surface of the lower manual engage the lower surface of the upper manual's keys. Depending on choice of keyboard and coupler position, the player can select any of the sets of jacks labeled in figure 4 as A, or B and C, or all three.

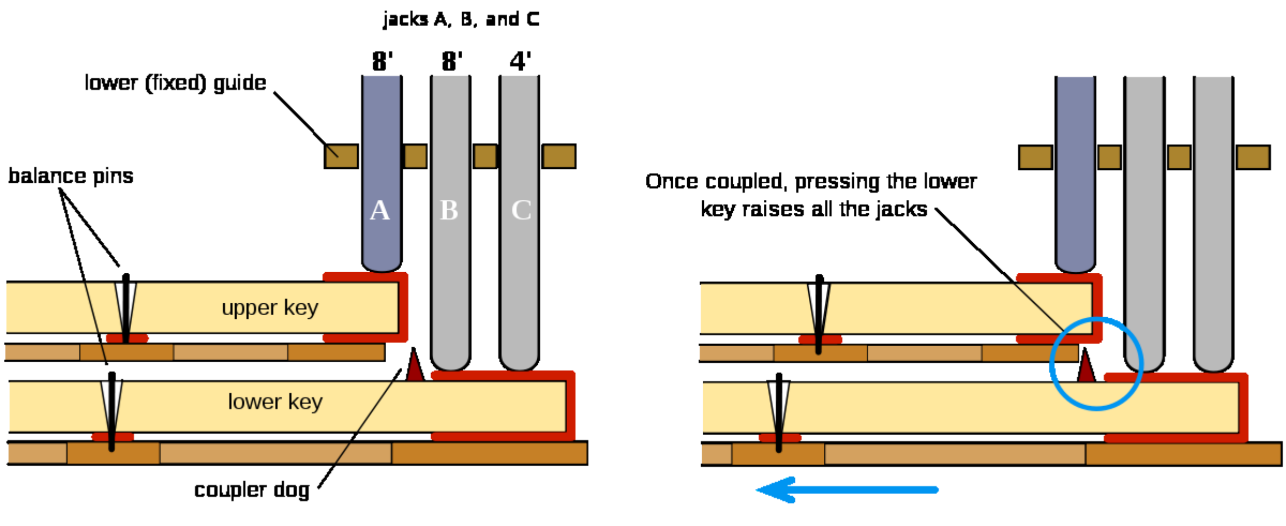


Figure 4. French shove coupler. To the left: uncoupled keyboards. The depressed upper key lifts the jack A upwards. The depressed lower key lifts jacks B and C. To the right: The upper keyboard is coupled to the lower one by pulling the latter. The depressed upper key lifts the jack A upwards. The depressed lower key lifts jacks A, B and C.

The English dogleg jack system (also practised in Baroque Flanders) does not require a coupler. The jacks labeled A in Figure 5 have a "dogleg" shape that permits A to be played by either keyboard. If the player wishes to play the upper 8' from the upper manual only and not from the lower manual, a stop handle disengages the jacks labeled A and engages instead an alternative row of jacks called "lute stop" (not shown in the Figure). Find full details in

Hubbard 1967, p.133 ff., Russell 1973, p.65 ff. and Kottick 2003.

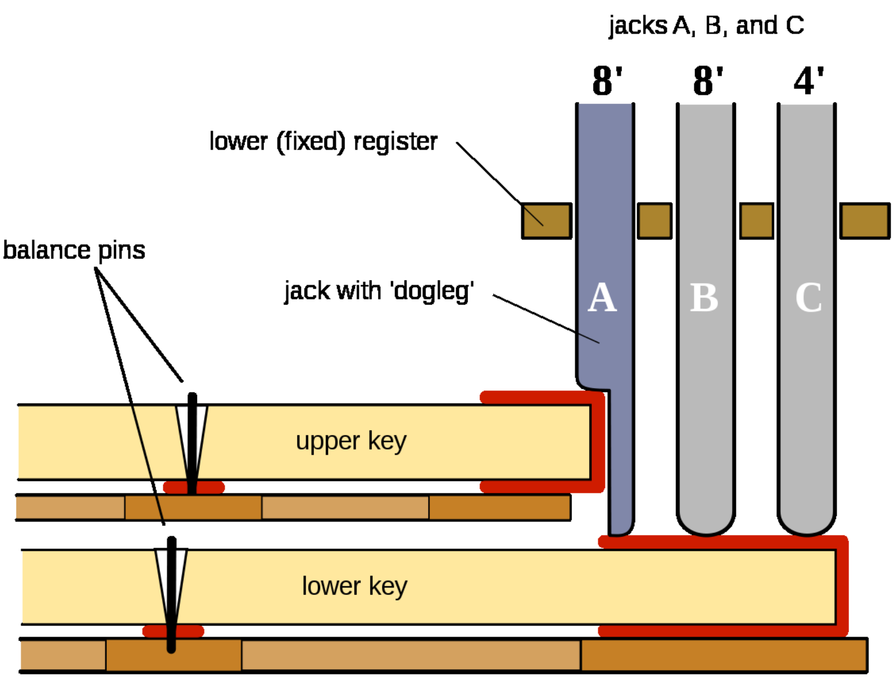


Figure 5. Dogleg jack, English coupler system. When depressed, the upper key lifts the "dogleg" jack (jack A) upwards. The lower key lifts all three jacks A, B, and C.

The use of multiple manuals in a harpsichord was not originally provided for the flexibility in choosing which strings would sound, but rather for transposition; for discussion see *History of the harpsichord*.

The case

Jan Vermeer's famous painting *A Lady Standing at a Virginal* shows the characteristic practice of his time, with the instrument mounted on a table and the player standing.

The case holds in position all of the important structural members: pinblock, soundboard, hitchpins, keyboard, and the jack action. It usually includes a solid bottom, and also internal bracing to maintain its form without warping under the tension of the strings. Cases vary greatly in weight and sturdiness: Italian harpsichords are often of light construction; heavier construction is found in the later Flemish instruments and those derived from them (see *History of the harpsichord*).

The case also gives the harpsichord its external appearance and protects the instrument. A large harpsichord is, in a sense, a piece of furniture, as it stands alone on legs and may be styled in the manner of other furniture of its place and period. Early Italian instruments, on the other hand, were so light in construction that they were treated rather like a violin: kept for storage in a protective outer case, and played after taking it out of its case and placing it on a table.[1] Such tables were often quite high - until the late 18th century people usually played standing up.[1] Eventually, harpsichords came to be built with just a single case, though an intermediate stage also existed: the "false inner–outer", which for purely aesthetic reasons was built to look as if the outer case contained an inner one, in the old style.[2] Even after harpsichords became self-encased objects, they often were supported by separate stands, and some modern harpsichords have separate legs for improved portability.

Many harpsichords have a lid that can be raised, a cover for the keyboard, and a stand for music.

Harpsichords have been decorated in a great many different ways: with plain buff paint (e.g. some Flemish instruments), with paper printed with patterns, with leather or velvet coverings, with chinoiserie, or occasionally with highly elaborate painted artwork.[3]

Variants

The terms used to denote the various members of the harpsichord family are now standardized. This was not so in the harpsichord's heyday.

Harpsichord

In modern usage, "harpsichord" can mean any member of the family of instruments. More often, though, it specifically denotes a grand-piano-shaped instrument with a roughly triangular case accommodating long bass strings at the left and short treble strings at the right. The characteristic profile of such a harpsichord is more elongated than a modern piano, with a sharper curve to the bentside.

Virginals

The virginal is a smaller and simpler rectangular form of the harpsichord having only one string per note; the strings run parallel to the keyboard, which is on the long side of the case.

Spinet

A spinet is a harpsichord with the strings set at an angle (usually about 30 degrees) to the keyboard. The strings are too close together for the jacks to fit between them. Instead, the strings are arranged in pairs, and the jacks are in the larger gaps between the pairs. The two jacks in each gap face in opposite directions, and each plucks a string adjacent to a gap.

Clavicytherium

A clavicytherium is a harpsichord with the soundboard and strings mounted vertically facing the player, the same space-saving principle as an upright piano.[4] In a clavicytherium, the jacks move horizontally without the assistance of gravity, so that clavicytherium actions are more complex than those of other harpsichords.

Some of the earliest harpsichords for which we have evidence are clavicytheria. One surviving example from the late 15th century is kept at the Royal College of Music in London.[4] For most of the history of the harpsichord, however, the clavicytherium was far less common than the horizontal instrument, probably because of its greater complexity and lesser reliability. In the 18th century fine clavicytheria were made by Albertus Delin, a Flemish builder.[5]

Ottavino

Ottavini are small spinets or virginals at four foot pitch. It is thought that harpsichords at octave pitch were more common in the late Mediæval times and the early Renaissance, but lessened in popularity later on. However, ottavini remained very popular as domestic instruments in Italy. In England, Samuel Pepys makes many mentions of his "tryangle" in his diary, which references the usual shape of these instruments. In the Low Countries, ottavini were commonly paired with an 8' virginals, encased in a small cubb under the soundboard. The ottavino could be removed and placed on top of the larger virginal, making an effect like unto a double manual instrument. These are sometimes called 'mother-and-child' or 'double' virginals.[6]

Other

The archicembalo, built in the 16th century, had an unusual keyboard layout, designed to accommodate variant tuning systems demanded by compositional practice and theoretical experimentation. More common were instruments with split sharps, also designed to accommodate the tuning systems of the time.

The folding harpsichord was an instrument that could be folded up for travel.

Occasionally, in late 18th c., harpsichords were built with a pedal keyboard. While these were mostly intended as practice instruments for organists, a few pieces are believed to have been written specifically for the pedal harpsichord.

Harpsichord by Alastair McAllister, Melbourne, 1999, and a rare pedal harpsichord, by Hubbard & Broekman, Boston, 1990

Compass and pitch range

On the whole, earlier harpsichords have smaller ranges and later ones larger, though there are many exceptions. The largest harpsichords have a range of just over five octaves and the smallest have under four. Usually, the shortest keyboards were given extended range in the bass with a "short octave".

Tuning pitch is often taken to be a=415 Hz, roughly a semitone lower than the modern standard concert pitch of a=440 Hz. An accepted exception is for French baroque repertoire which is often performed with a=392 Hz, approximately a semitone lower again. Tuning an instrument nowadays usually starts with setting an A; historically it would commence from a C or an F.

Some modern instruments are built with keyboards which can be shifted sideways, allowing the player to align the mechanism with strings at either a=415 Hz or a=440 Hz. If a tuning other than equal temperament is used, the instrument requires retuning once the keyboard is shifted.[7]

History

Ruckers-Taskin (1646/1780) harpsichord, (Paris, Musée de la Musique)

The harpsichord was most probably invented in the late Middle Ages. By the 16th century, harpsichord makers in Italy were making lightweight instruments with low string tension. A different approach was taken in Flanders starting in the late 16th century, notably by the Ruckers family. Their harpsichords used a heavier construction and produced a more powerful and distinctive tone. They included the first harpsichords with two keyboards, used for transposition.

The Flemish instruments served as the model for 18th century harpsichord construction in other nations. In France, the double keyboards were adapted to control different choirs of strings, making a more musically flexible instrument. Instruments from the peak of the French tradition, by makers such as the Blanchet family and Pascal Taskin, are among the most widely admired of all harpsichords, and are frequently used as models for the construction of modern instruments. In England, the Kirkman and Shudi firms produced sophisticated harpsichords of great power and sonority. German builders extended the sound repertoire of the instrument by adding sixteen foot and two foot choirs; these instruments have recently served as models for modern builders.

In the late 18th century the harpsichord was supplanted by the piano and almost disappeared from view for most of the 19th century: an exception was its continued use in opera for accompanying recitative, but the piano sometimes displaced it even there. 20th century efforts to revive the harpsichord began with instruments that used piano technology, with heavy strings and metal frames. Starting in the middle of the 20th century, ideas about harpsichord making underwent a major change, when builders such as Frank Hubbard, William Dowd, and Martin Skowroneck sought to re-establish the building traditions of the Baroque period. Harpsichords of this type of historically informed building practice dominate the current scene.

Music for the harpsichord

Historical period

The great bulk of the standard repertoire for the harpsichord was written during its first historical flowering, the Renaissance and Baroque eras.

The first music written specifically for solo harpsichord was published around the early 16th century. Composers who wrote solo harpsichord music were numerous during the whole Baroque era in European countries including Italy, Germany, England and France. Solo harpsichord compositions included dance suites, fantasias, and fugues. Among the most famous composers who wrote for the harpsichord were the members of English virginal school of the late Renaissance, notably William Byrd (ca. 1540 – 1623). In France, a great number of highly characteristic solo works were created and compiled into four books of *ordres* by François Couperin (1668-1733). Domenico Scarlatti (1685–1757) began his career in Italy but wrote most of his solo harpsichord works in Spain; his most famous work is his series of 555 harpsichord sonatas. Perhaps the most celebrated composer who wrote for the harpsichord was J. S. Bach (1685-1750), whose solo works (for instance, the Well-Tempered Clavier and the Goldberg Variations), continue to be performed very widely, often on the piano. Bach was also a pioneer of the harpsichord concerto, both in works designated as such, and in the harpsichord part of his Fifth Brandenburg Concerto.

Two of the most prominent composers of the Classical period (music), Joseph Haydn (1732-1809) and Wolfgang Amadeus Mozart (1756-1791), wrote harpsichord music. For both, the instrument featured in the earlier period of their careers and was abandoned once they had shifted their efforts to the piano.

Besides solo works, the historical harpsichord was widely used for accompaniment in the basso continuo style (a function it maintained in operatic recitative even into the 19th century).

Music written for the revived harpsichord

Through the 19th century, the harpsichord was almost completely supplanted by the piano. In the 20th century, composers returned to the instrument, as they sought out variation in the sounds available to them. Under the influence of Arnold Dolmetsch, the harpsichordists Violet Gordon-Woodhouse (1872–1951) and in France, Wanda Landowska (1879–1959), were at the forefront of the instrument's renaissance.

Concertos for the instrument were written by Francis Poulenc (the *Concert champêtre*, 1927–28), Manuel de Falla, Bertold Hummel,[8] Henryk Mikołaj Górecki, Michael Nyman, Philip Glass, and Roberto Carnevale. Bohuslav Martinů wrote both a concerto and a sonata for the instrument, and Elliott Carter's *Double Concerto* is scored for harpsichord, piano and two chamber orchestras.

In chamber music, György Ligeti wrote a small number of solo works for the instrument (including *Continuum*), and Henri Dutilleux's *Les Citations* (1991) is scored for harpsichord, oboe, double bass and percussions. Elliott Carter's *Sonata for Flute, Oboe, Cello and Harpsichord* (1952) explores the timbre possibilities of the modern harpsichord. Josef Tal wrote *Concerto for harpsichord & electronic music* (1964) and *Chamber Music* (1982) for s-recorder, marimba & harpsichord. Both Dmitri Shostakovich (*Hamlet*, 1964) and Alfred Schnittke (*Symphony No.8*, 1998) wrote works that use the harpsichord as part of the orchestral texture.

In the Preface to his piano collection *Mikrokosmos*, Bela Bartok suggests some ten pieces as being suitable for the harpsichord.

Harpsichordist Hendrik Bouman has composed pieces in the 17th and 18th century style, including works for solo harpsichord, harpsichord concerti, and other works that call for harpsichord continuo. Other contemporary composers writing new harpsichord music in period styles include Grant Colburn, Miguel Robaina, Fernando De Luca and Gianluca Bersanetti. Notable performers include Oscar Milani and Mario Raskin.

During the second half of the 20th century, the sound of the harpsichord (or perhaps rather more often, its electronically created equivalent) became very familiar in popular culture, appearing frequently in popular music,

television, films, computer games, and so on.

Notes

[1] Hubbard 1967, 19
[2] Hubbard 1967, 20
[3] Hubbard 1967, various locations
[4] Dearling 1996, 138
[5] Hubbard 1967, 77
[6] Marchand, Leslie Alexis (1973). *Byron's letters and journals: 1816-1817 : 'So late into the night'*. Harvard: Harvard University Press. p. 75. ISBN 9780674089457. "Model IX is the famous double virginal. An ottavino of model VIII is inserted into the case of the virginal like a drawer slipping into a bureau."
[7] http://www.hubharp.com/technical_articles2/soundboard_transposingkeyboard.htm
[8] Bertold Hummel list of works (http://www.bertoldhummel.de/english/register/register.html): Op. 15 is his *Divertimento capriccioso* for harpsichord and chamber orchestra.

References

- Boalch, Donald H. (1995) *Makers of the Harpsichord and Clavichord, 1440-1840*, 3rd ed., with updates by Andreas H. Roth and Charles Mould, Oxford University Press, ISBN 0-19-318429-X. A catalogue, originating with work by Boalch in the 1950s, of all extant historical instruments.
- Dearling, Robert (ed.) (1996) *The ultimate encyclopedia of musical instruments*, London : Carlton, ISBN 1-85868-185-5
- Hubbard, Frank (1967) *Three Centuries of Harpsichord Making*, 2nd ed., Harvard University Press, ISBN 0-674-88845-6. An authoritative survey by a leading builder of how early harpsichords were built and how the harpsichord evolved over time in different national traditions.
- Kottick, Edward (2003) *A History of the Harpsichord*, Indiana University Press, ISBN 0-253-34166-3. An extensive survey by a leading contemporary scholar.
- O'Brien, Grant (1990) *Ruckers, a harpsichord and virginal building tradition*, Cambridge University Press, ISBN 0-521-36565-1. Covers the innovations of the Ruckers family, the founders of the Flemish tradition.
- Russell, Raymond (1973)*The Harpsichord and Clavichord: an introductory study*, 2nd ed., London : Faber and Faber, ISBN 0-571-04795-5
- Skowroneck, Martin (2003) *Cembalobau: Erfahrungen und Erkenntnisse aus der Werkstattpraxis = Harpsichord construction: a craftsman's workshop experience and insight*, Fachbuchreihe Das Musikinstrument **83**, Bergkirchen : Bochinsky, ISBN 3-932275-58-6. A study (written in English and German) of harpsichord building by a leading figure in the modern revival of historically authentic methods of building.
- Zuckermann, Wolfgang (1969) *The Modern Harpsichord: twentieth century instruments and their makers*, New York : October House, ISBN 0-8079-0165-2

External links

Instruments

- "Queen Elizabeth's Virginal" (http://www.vam.ac.uk/collections/furniture/stories/virginal/index.html). *Furniture*. Victoria and Albert Museum. Retrieved 2007-08-12.
- A few historic harpsichords from the collection at The Metropolitan Museum of Art
  - Double virginal by Hans Ruckers, Antwerp, 1581 (http://www.metmuseum.org/toah/hd/renk/ho_29.90.htm)
  - Harpsichord by Girolamo Zenti, Rome, 1666 (http://www.metmuseum.org/toah/hd/cris/ho_89.4.1220.htm)

    - Harpsichord by Jan Couchet, Antwerp, 1650 (http://www.metmuseum.org/toah/ho/09/euwl/ho_89.4.2363.htm)
    - Octave virginal, Augsburg, ca. 1600 (http://www.metmuseum.org/toah/hd/renk/ho_89.4.1778.htm)
    - Spinnetta or Virginal, Venice, ca. 1540 (http://www.metmuseum.org/toah/hd/renk/ho_53.6ab.htm)
    - Golden Harpsichord by Michele Todini, Rome, ca. 1675 (http://www.metmuseum.org/toah/hd/baro/ho_89.4.2929.htm)
    - Harpsichord, Italy, late 17th century (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/harpsichord/objectview.aspx?page=1&sort=0&sortdir=asc&keyword=harpsichord&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180015401&vT=1)
    - Harpsichord by Pleyel et Cie, Paris, 1928 (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/harpsichord_pleyel_et_cie/objectview.aspx?page=1&sort=0&sortdir=asc&keyword=harpsichord&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180015607&vT=1)
- A harpsichord constructed from Lego (http://www.henrylim.org/Harpsichord.html)

History

- *Italian Harpsichord-Building in the 16th and 17th Centuries* (http://www.gutenberg.org/etext/27149) by Shortridge

Listen

- Hear the sound of various harpsichords (http://www-personal.umich.edu/~bpl/hpsi.html)
- *Sala del Cembalo*, free harpsichord sound files (http://www.saladelcembalo.org/archivio.php)

Images

- *HarpsichordPhoto*, photographs of early stringed keyboard instruments (http://HarpsichordPhoto.org/)

Organisations

- British Harpsichord Society (http://www.harpsichord.org.uk)

Craftsman insights

- Interview with harpsichord builder Jack Peters (http://www.learningmusician.com/features/1106/JackPeters/)

Music

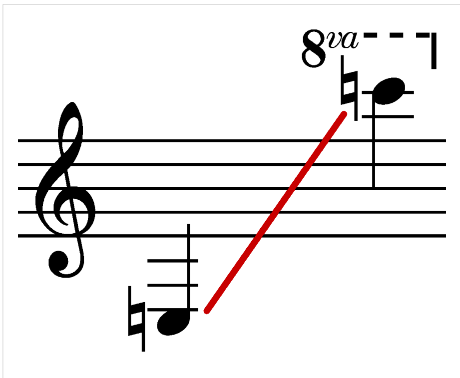
- Scores featuring the harpsichord: Free scores at the International Music Score Library Project.
- *Procembalo* (http://www.procembalo.org) free catalog of contemporary harpsichord music

Clarinet

Clarinet

B♭ Clarinet (Boehm system)

Woodwind instrument	
Classification	Wind Woodwind Single-reed
Hornbostel-Sachs classification	422.211.2-71 (Single-reeded aerophone with keys)
Playing range	
Written range (though it is possible to play higher):	



Related instruments

- Saxophone
- Tárogató (modern)
- Oboe
- Chalumeau

Musicians

- Clarinetists

The **clarinet** is a musical instrument of woodwind type. The name derives from adding the suffix *-et* (meaning *little*) to the Italian word *clarino* (meaning a type of trumpet), as the first clarinets had a strident tone similar to that of a trumpet. The instrument has an approximately cylindrical bore, and uses a single reed. In jazz contexts, it has sometimes been informally referred to as the "licorice stick."[1]

Clarinets comprise a family of instruments of differing sizes and pitches. The clarinet family is the largest such woodwind family, with more than a dozen types, ranging from the (extremely rare) BBB♭ octo-contrabass to the A♭ soprano (piccolo clarinet). Of these, many are rare or obsolete (there is only one BBB♭ octo-contrabass clarinet in existence, for example), and music written for them is usually played on the common types. The unmodified word

clarinet usually refers to the B♭ soprano clarinet, by far the most commonly played clarinet.

A person who plays the clarinet is called a clarinetist or clarinettist. Johann Christoph Denner invented the clarinet in Germany around the turn of the 18th century by adding a register key to the earlier chalumeau. Over time, additional keywork and airtight pads were added to improve tone and playability. Today, the clarinet is used in jazz and classical ensembles, in chamber groups, and as a solo instrument.

Characteristics

Tone

The cylindrical bore is primarily responsible for the clarinet's distinctive timbre, which varies between its three main registers, known as the chalumeau, clarino, and altissimo. The tone quality can vary greatly with the musician, the music, the instrument, the mouthpiece, and the reed. The differences in instruments and geographical isolation of players in different countries led to the development, from the last part of the 18th century onwards, of several different schools of clarinet playing. The most prominent were the German/Viennese traditions and the French school. The latter was centered on the clarinetists of the Conservatoire de Paris.[2] The proliferation of recorded music has made examples of different styles of clarinet playing available. The modern clarinetist has a diverse palette of "acceptable" tone qualities to choose from.[2]

The A clarinet and B♭ clarinet have nearly the same bore, and use the same mouthpiece.[3] Orchestral players using the A and B♭ instruments in the same concert use the same mouthpiece (and often the same barrel) for both (see 'usage' below). The A and the B♭ instruments have nearly identical tonal quality, although the A typically has a slightly warmer sound.[3] The tone of the E♭ clarinet is brighter than that of the lower clarinets and can be heard even through loud orchestral textures.[4] The bass clarinet has a characteristically deep, mellow sound,[2] while the alto clarinet is similar in tone to the bass and the basset horn has a tone quality comparable to the A clarinet.

Bass clarinet

Range

Clarinets have the largest pitch range of common woodwinds.[5] The intricate key organization that makes this range possible can make the playability of some passages awkward. The bottom of the clarinet's written range is defined by the keywork on each instrument, standard keywork schemes allow a low E on the common B♭ clarinet. The lowest concert pitch depends on the transposition of the instrument in question.

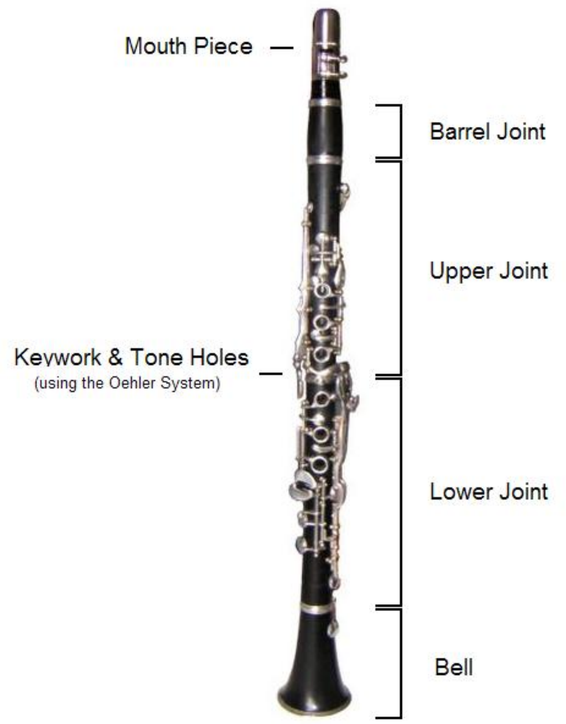
Nearly all soprano and piccolo clarinets have keywork enabling them to play the E below middle C (E_3 in scientific pitch notation) as their lowest written note, though some B♭ clarinets go down to $E♭_3$ to enable them to match the range of the A clarinet.[6] On the B♭ soprano clarinet, the concert pitch of the lowest note is D_3, a whole tone lower than the written pitch. Most alto and bass clarinets have an extra key to allow a (written) $E♭_3$. Modern professional-quality bass clarinets generally have additional keywork to written C_3.[7] Among the less commonly encountered members of the clarinet family, contra-alto and contrabass clarinets may have keywork to written $E♭_3$, D_3, or C_3;[8] the basset clarinet and basset horn generally go to low C_3.[2]

Defining the top end of a clarinet's range is difficult, since many advanced players can produce notes well above the highest notes commonly found in method books. The G two octaves above G_4 is usually the highest note clarinetists encounter in classical repertoire.[9] The C above that (C_7 i.e. resting on the fifth ledger line above the treble staff) is attainable by advanced players and is shown on many fingering charts,[9] and fingerings as high as E_7 exist.[10]

The range of a clarinet can be divided into three distinct registers. The lowest register, consisting of the notes up to the written B♭ above middle C ($B\flat_4$), is known as the *chalumeau* register (named after the instrument that was the clarinet's immediate predecessor). The middle register is termed the *clarino* (sometimes *clarion*) register[11] and spans just over an octave (from written B above middle C (B_4) to the C two octaves above middle C (C_6));[9] it is the dominant range for most members of the clarinet family. The top or *altissimo* register consists of the notes above the written C two octaves above middle C (C_6).[9] Unlike other woodwinds, all three registers have characteristically different sounds. The chalumeau register is rich and dark. The clarino register is brighter and sweet, like a trumpet heard from afar ("clarino" means trumpet). The altissimo register can be piercing and sometimes shrill.

Construction

Materials



The Construction of a Clarinet (Oehler system)

Clarinet bodies have been made from a variety of materials including wood, plastic, hard rubber, metal, resin, and ivory.[12] The vast majority of clarinets used by professional musicians are made from African hardwood, mpingo (African Blackwood) or grenadilla, rarely (because of diminishing supplies) Honduran rosewood and sometimes even cocobolo.[13] Historically other woods, notably boxwood, were used.[13]

Most modern, inexpensive instruments are made of plastic resin, such as ABS.[13] These materials are sometimes called "resonite", which is Selmer's trademark name for its type of plastic. Metal soprano clarinets were popular in the early twentieth century, until plastic instruments supplanted them;[14] metal construction is still used for the bodies of some contra-alto and contrabass clarinets, and for the necks and bells of nearly all alto and larger clarinets.[2] Ivory was used for a few 18th century clarinets, but it tends to crack and does not keep its shape well.[15]

Buffet Crampon's Greenline clarinets are made from a composite of grenadilla wood powder and carbon fiber.[16] Such instruments are less affected by humidity and temperature changes than wooden instruments but are heavier. Hard rubber, such as ebonite, has been used for clarinets since the 1860s, although few modern clarinets are made of it. Clarinet designers Alastair Hanson and Tom Ridenour are strong advocates of hard rubber.[17] Hanson Clarinets of England manufactures clarinets using a grenadilla compound reinforced with ebonite, known as 'BTR' (bithermal reinforced) grenadilla. This material is also not affected by humidity, and the weight is the same as that of a wood clarinet.

Mouthpieces are generally made of hard rubber, although some inexpensive mouthpieces may be made of plastic.[3] Other materials such as crystal/glass, wood, ivory, and metal have also been used.[3] Ligatures are often made out of metal and plated in nickel, silver or gold.[3] Other ligature materials include wire, wire mesh, plastic, naugahyde, string, or leather.[18]

Reed

The instrument uses a single reed made from the cane of *Arundo donax*, a type of grass.[19] Reeds may also be manufactured from synthetic materials. The ligature fastens the reed to the mouthpiece. When air is blown through the opening between the reed and the mouthpiece facing, the reed vibrates and produces the instrument's sound.

Basic reed measurements are as follows: tip, 12 millimetres (0.47 in) wide; lay, 15 millimetres (0.59 in) long (distance from the place where the reed touches the mouthpiece to the tip); gap, 1 millimetre (0.039 in) (distance between the underside of the reed tip and the mouthpiece). Adjustment to these measurements is one method of affecting tone color.[20]

Most clarinetists buy manufactured reeds, although many make adjustments to these reeds and some make their own reeds from cane "blanks".[21] Reeds come in varying degrees of hardness, generally indicated on a scale from one (soft) through five (hard). This numbering system is not standardized — reeds with the same hardness number often vary in hardness across manufacturers and models.[18] Reed and mouthpiece characteristics work together to determine ease of playability, pitch stability, and tonal characteristics.[18]

Components of a modern soprano clarinet

Note: A Boehm system soprano clarinet is shown in the photos illustrating this section. However, all modern clarinets have similar components.

Clarinet reed, mouthpiece, and ligature

The *reed* is attached to the *mouthpiece* by the *ligature*, and the top half-inch or so of this assembly is held in the player's mouth.[2] German clarinetists often wrap a string around the mouthpiece and reed instead of using a ligature.[3] The formation of the mouth around the mouthpiece and reed is called the *embouchure*.

The reed is on the underside of the mouthpiece, pressing against the player's lower lip, while the top teeth normally contact the top of the mouthpiece (some players roll the upper lip under the top teeth to form what is called a 'double-lip' embouchure).[3] Adjustments in the strength and shape of the embouchure change the tone and intonation (tuning). It is not uncommon for clarinetists to employ methods to relieve the pressure on the upper teeth and inner lower lip by attaching pads to the top of the mouthpiece or putting (temporary) padding on the front lower teeth, commonly from folded paper.[3]

Barrel of a B♭ soprano Clarinet

Next is the short *barrel*; this part of the instrument may be extended to fine-tune the clarinet. As the pitch of the clarinet is fairly temperature-sensitive, some instruments have interchangeable barrels whose lengths vary slightly. Additional compensation for pitch variation and tuning can be made by pulling out the barrel and thus increasing the instrument's length, particularly common in group playing in which clarinets are tuned to other instruments (such as in an orchestra). Some performers use a plastic barrel with a thumbwheel that enables the barrel length to be altered. On basset horns and lower clarinets, the barrel is normally replaced by a curved metal neck.

Upper Joint of a Boehm-System Clarinet

The main body of most clarinets is divided into the *upper joint*, the holes and most keys of which are operated by the left hand, and the *lower joint* with holes and most keys operated by the right hand. Some clarinets have a single joint: on some basset horns and larger clarinets the two joints are held together with a screw clamp and are usually not disassembled for storage. The left thumb operates both a *tone hole* and the *register key*. On some models of clarinet, such as many Albert system clarinets and increasingly some higher-end Boehm system clarinets, the register key is a 'wraparound' key, with the key on the back of the clarinet and the pad on the front. Advocates of the wraparound register key say it improves sound, and it is harder for moisture to accumulate in the tube beneath the pad.[22]

The body of a modern soprano clarinet is equipped with numerous *tone holes* of which seven (six front, one back) are covered with the fingertips, and the rest are opened or closed using a set of keys. These tone holes allow every note of the chromatic scale to be produced. On alto and larger clarinets and a few soprano clarinets, some or all finger holes are replaced by key-covered holes. The most common system of keys was named the Boehm System by its designer Hyacinthe Klosé in honour of flute designer Theobald Boehm, but it is not the same as the Boehm System used on flutes.[23] The other main system of keys is called the Oehler system and is used mostly in Germany and Austria (see History).[2] The related Albert system is used by some jazz, klezmer, and eastern European folk musicians.[2] The Albert and Oehler systems are both based on the early Mueller system.[2]

The cluster of keys at the bottom of the upper joint (protruding slightly beyond the cork of the joint) are known as the *trill keys* and are operated by the right hand.[18] These give the player alternative fingerings that make it easy to play ornaments and trills.[18] The entire weight of the smaller clarinets is supported by the right thumb behind the lower joint on what is called the *thumb-rest*.[24] Basset horns and larger clarinets are supported with a neck strap or a floor peg.

Lower Joint of a Boehm-System Clarinet

Bell of a B♭ soprano clarinet

Finally, the flared end is known as the *bell*. Contrary to popular belief, the bell does not amplify the sound; rather, it improves the uniformity of the instrument's tone for the lowest notes in each register.[25] For the other notes the sound is produced almost entirely at the tone holes and the bell is irrelevant.[25] On basset horns and larger clarinets, the bell curves up and forward and is usually made of metal.[2]

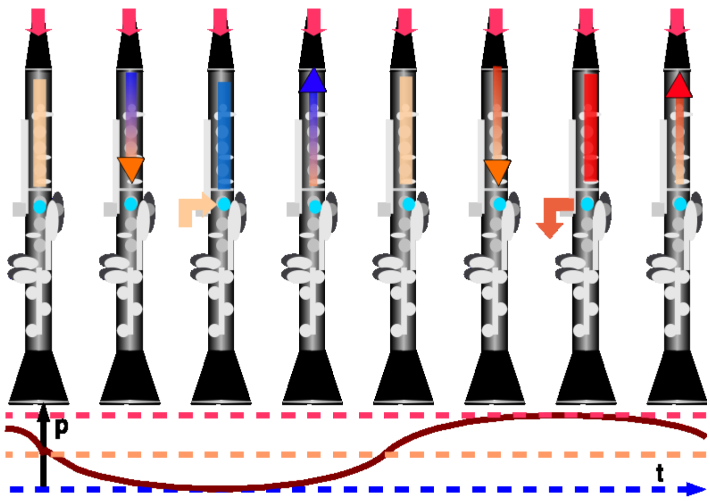
Boehm Keywork and sample fingerings of a modern soprano clarinet

Theobald Boehm did not directly invent the key system of the clarinet. Boehm was a flautist who created the key system that is now used for the Transverse Flute. Klosé and Buffet applied Boehm's system to the Clarinet. Although the credit goes to those people, Boehm's name was given to that key system.

The current Boehm key system consists of generally 6 rings, on the thumb, 1st, 2nd, 4th, 5th and 6th holes, a register key just above the thumb hole, easily accessible with the thumb. Above the 1st hole, there is a key that lifts two covers creating the note A in the throat register (high part of low register) of the clarinet. A key at the side of the instrument at the same height as the A key lifts only one of the two covers, producing G# a semitone lower. The A key can be used in conjunction solely with the register key to produce A#/Bb.

Acoustics

Sound is a wave that propagates through the air as a result of a local variation in air pressure. The production of sound by a clarinet follows these steps:[25]



Vibration of the air column in the soprano clarinet[26]

1. The air in the bore of the instrument is at normal atmospheric pressure and moves towards the bell (or the first open hole). The minuscule space between the mouthpiece and the reed allows only a small amount of air to enter the instrument. This creates a low-pressure area in the mouthpiece. The difference in pressure between the two sides of the reed increases, causing the reed to press against the mouthpiece.
2. The wave of low-pressure air moves down the bore and arrives at the first open hole.
3. The outside air, at normal atmospheric pressure, is sucked in by the low pressure inside. The air that was previously leaving the clarinet through the hole changes direction quickly and enters the bore.
4. The incoming air normalizes the pressure within the bore, starting at the open hole and moving back towards the mouthpiece.
5. Once all the air in the bore is at atmospheric pressure (moving towards the mouthpiece), the difference in pressure between the two sides of the reed decreases and the reed returns to its original position.
6. The moving column of air is stopped by the sudden collision with the pressurized air coming from the player's mouth. A wave of high-pressure air moves towards the first open hole.
7. When the high-pressure air arrives at the open hole, the air coming into the bore abruptly changes direction and goes out through the hole.
8. The high pressure normalizes and the cycle restarts.

The cycle repeats at a constant frequency and emits a note related to that frequency. For example, A4 (440 Hz) is produced when the cycle repeats 440 times per second.[27]

The bore of the soprano clarinet is cylindrical for most of the tube with an inner bore diameter between 14 and 15.5 millimetres (0.55 and 0.61 in), but there is a subtle hourglass shape, with the thinnest part below the junction between the upper and lower joint.[28] The reduction is 1 to 3 millimetres (0.039 to 0.12 in) depending on the maker. This hourglass shape, although not visible to the naked eye, helps to correct the pitch/scale discrepancy between the chalumeau and clarino registers (perfect 12th).[28] The diameter of the bore affects characteristics such as available

harmonics, timbre, and stability of pitch (the extent to which a note can be 'bent' in the manner required in jazz and other styles of music). The bell at the bottom of the instrument flares out to improve the tone of the lowest notes.

Most modern clarinets have "undercut" tone holes to improve intonation and the sound. Undercutting means chamfering the bottom edge of tone holes inside the bore. Acoustically, this makes the tone hole function as if it were larger, but its main function is to allow the air column to follow the curve up through the tone hole (surface tension) instead of "blowing past" it under the increased velocity of the upper registers.[29]

The fixed reed and fairly uniform diameter of the clarinet give the instrument an acoustical behavior approximating that of a cylindrical stopped pipe.[25] Recorders use a tapered internal bore to overblow at the 8th (octave) when its thumb/register hole is pinched open while the clarinet, with its cylindrical bore, overblows on the 12th. Adjusting the angle of the bore taper controls the frequencies of the overblown notes (harmonics).[25] Changing the mouthpiece's tip opening and the length of the reed changes the harmonic timbre or voice of the instrument because this changes the speed of reed vibrations.[25] Generally, the goal of the clarinetist when producing a sound is to make as much of the reed vibrate as possible, making the sound fuller, warmer, and potentially louder.

Covering or uncovering the tone holes varies the length of the pipe, changing the resonant frequencies of the enclosed air column and hence the pitch of the sound.[25] A clarinetist moves between the chalumeau and clarino registers through use of the register key, or speaker key: clarinetists call the change from chalumeau register to clarino register "the break".[18] The register key, when pressed, cancels the fundamental frequency scale and forces the clarinet to produce the next dominant harmonic scale a twelfth higher, and when using at least fingers 1-2-3 1-2, taking off the first finger on the left hand, acts as another register key, and doesn't overblow a twelfth, but instead a sixth. The clarinet is therefore said to overblow at the twelfth, and when moving to the altissimo register, a sixth. By contrast, nearly all other woodwind instruments overblow at the octave, or like the Ocarina and Tonette, do not overblow at all (the Rackett or Sausage Bassoon is the next most common Western instrument that overblows at the twelfth). A clarinet must have holes and keys for nineteen notes (a chromatic octave and a half, from bottom E to B♭) in its lowest register to play the chromatic scale. This overblowing behavior explains the clarinet's great range and complex fingering system. The fifth and seventh harmonics are also available, sounding a further sixth and fourth (a flat, diminished fifth) higher respectively; these are the notes of the altissimo register.[25] This is also why the inner "waist" measurement is so critical to these harmonic frequencies.

The highest notes on a clarinet can have a shrill piercing quality and can be difficult to tune accurately.[3] Different instruments often play differently in this respect due to the sensitivity of the bore and reed measurements. Using alternate fingerings and adjusting the embouchure helps correct the pitch of these higher notes.

Since approximately 1850, clarinets have been nominally tuned according to 12-tone equal temperament. Older clarinets were nominally tuned to meantone. A skilled performer can use his or her embouchure to considerably alter the tuning of individual notes or to produce vibrato, a pulsating change of pitch often employed in jazz.[30] Vibrato is rare in classical or concert band literature; however, certain clarinetists, such as Richard Stoltzman, do use vibrato in classical music. Special fingerings may be used to play quarter tones and other microtonal intervals.[31] Fritz Schüller of Markneukirchen, Germany built a quarter tone clarinet, with two parallel bores of slightly different lengths whose tone holes are operated using the same keywork and a valve to switch from one bore to the other.[2]

Schüller's quarter-tone clarinet

History

Lineage

4-key boxwood clarinet, ca. 1760.

The clarinet has its roots in the early single-reed instruments or hornpipes used in the Middle East and Europe since the Middle Ages, such as the albogue, alboka, and double clarinet.[2]

The modern clarinet developed from a Baroque instrument called the chalumeau. This instrument was similar to a recorder, but with a single-reed mouthpiece and a cylindrical bore.[32] Lacking a register key, it was played mainly in its fundamental register, with a limited range of about one and a half octaves.[32] It had eight finger holes, like a recorder, and two keys for its two highest notes.[32] At this time, contrary to modern practice, the reed was placed in contact with the upper lip.[32]

Around the turn of the 18th century, the chalumeau was modified by converting one of its keys into a register key to produce the first clarinet. This development is usually attributed to German instrument maker Johann Christoph Denner, though some have suggested his son Jacob Denner was the inventor.[33] This instrument played well in the middle register with a loud, shrill sound, so it was given the name *clarinetto* meaning "little trumpet" (from *clarino* + *-etto*). Early clarinets did not play well in the lower register, so chalumeaux continued to be made to play the low notes.[32] As clarinets improved, the chalumeau fell into disuse and these notes became known as the *chalumeau register*. The original Denner clarinets had two keys, and could play a chromatic scale, but various makers added more keys to get improved tuning, easier fingerings, and a slightly larger range.[32] The classical clarinet of Mozart's day typically had eight finger holes and five keys.

Clarinets were soon accepted into orchestras. Later models had a mellower tone than the originals. Mozart (d. 1791) liked the sound of the clarinet (he considered its tone the closest in quality to the human voice) and wrote numerous pieces for the instrument.,[34] and by the time of Beethoven (c. 1800–1820), the clarinet was a standard fixture in the orchestra.

Pads

The next major development in the history of clarinet was the invention of the modern pad. Early clarinets covered the tone holes with felt pads.[35] Because these leaked air, the pads had to be kept to a minimum, so the clarinet was severely restricted in what notes could be played with good tone.[35] In 1812, Iwan Müller, a Russian-born clarinetist and inventor, developed a new type of pad that was covered in leather or fish bladder.[36] This was completely airtight, so the number of keys could be increased enormously. He designed a new type of clarinet with seven finger holes and thirteen keys.[36] This allowed the clarinet to play in any key with near-equal ease. Over the course of the 19th century, many enhancements were made to Mueller's clarinet, such as the Albert system and the Baermann system, all keeping the same basic design.

Arrangement of keys and holes


Oehler system clarinets use additional tone holes to correct intonation (patent C♯, low E-F correction, fork-F/B♭ correction and fork B♭ correction)

The final development in the modern design of the clarinet used in most of the world today was introduced by Hyacinthe Klosé in 1839.[37] He devised a different arrangement of keys and finger holes, which allow simpler fingering. It was inspired by the Boehm System developed for flutes by Theobald Boehm. Klosé was so impressed by Boehm's invention that he named his own system for clarinets the Boehm system, although it is different from the one used on flutes.[37] This new system was slow to gain popularity because it meant the player had to relearn how to play the instrument. To ease this transition, Klose wrote a series of exercises for the clarinet, designed to teach his fingering system. Gradually it became the standard, and today the Boehm system is used everywhere in the world except Germany and Austria. These countries still use a direct descendant of the Mueller clarinet known as the Oehler system clarinet.[2] Also, some contemporary Dixieland and Klezmer players continue to use Albert system clarinets, as the simpler fingering system can allow for easier slurring of notes.[2] At one time the reed was held on using string, but now the practice exists primarily in Germany and Austria.

Usage and repertoire

Use of multiple clarinets

The modern orchestral standard of using soprano clarinets in both B♭ and A has to do partly with the history of the instrument, and partly with acoustics, aesthetics and economics. Before about 1800, due to the lack of airtight pads *(see History)*, practical woodwinds could have only a few keys to control accidentals (notes outside their diatonic home scales).[35] The low (chalumeau) register of the clarinet spans a twelfth (an octave plus a perfect fifth), so the clarinet needs keys to produce all nineteen notes in that range.[2] This involves more keywork than is necessary on instruments that "overblow" at the octave — oboes, flutes, bassoons, and saxophones, for example, which need only twelve notes before overblowing.

Clarinets with few keys cannot therefore easily play chromatically, limiting any such instrument to a few closely related key signatures.[38] For example, an eighteenth-century clarinet in C could be played in F, C, and G (and their relative minors) with good intonation, but with progressive difficulty and poorer intonation as the key moved away from this range.[38] In contrast, for octave-overblowing instruments, an instrument in C with few keys could much more readily be played in any key.

This problem was overcome by using three clarinets — in A, B♭ and C — so that early 19th century music, which rarely strayed into the remote keys (five or six sharps or flats), could be played as follows: music in 5 to 2 sharps (B

major to D major concert pitch) on A clarinet (D major to F major for the player), music in 1 sharp to 1 flat (G to F) on C clarinet, and music in 2 flats to 4 flats (B♭ to A♭) on the B♭ clarinet (C to B♭ for the player). Difficult key signatures and numerous accidentals were thus largely avoided.

With the invention of the airtight pad, and as key technology improved and more keys were added to woodwinds, the need for clarinets in multiple musical keys was reduced.[2] However, the use of multiple instruments in different keys persisted, with the three instruments in C, B♭ and A all used as specified by the composer.

The lower-pitched clarinets sound more "mellow" (less bright), and the C clarinet — being the highest and therefore brightest of the three — fell out of favour as the other two clarinets could cover its range and their sound was considered better.[38] While the clarinet in C began to fall out of general use around 1850, some composers continued to write C parts after this date, e.g. Bizet's Symphony in C (1855), Tchaikovsky's Symphony No. 2 (1872), Smetana's *Vltava* (1874), Brahms Symphony No. 4 (1885), and Richard Strauss deliberately reintroduced it to take advantage of its brighter tone, as in *Der Rosenkavalier* (1911).[2]

While technical improvements and an equal-tempered scale reduced the need for two clarinets, the technical difficulty of playing in remote keys persisted and the A has thus remained a standard orchestral instrument.[2] In addition, by the late 19th century the orchestral clarinet repertoire contained so much music for clarinet in A that the disuse of this instrument was not practical.[2] Attempts were made to standardise to the B♭ instrument between 1930 and 1950 (e.g. tutors recommended learning the routine transposition of orchestral A parts on the B♭ clarinet, including solos written for A clarinet, and some manufacturers provided a low E♭ on the B♭ to match the range of the A), but this failed in the orchestral sphere.

Similarly there have been E♭ and D instruments in the upper soprano range, B♭, A, and C instruments in the bass range, and so forth; but over time the E♭ and B♭ instruments have become predominant.[2]

The B♭ instrument continues to be dominant in wind ensemble music and in jazz, with both B♭ and C instruments used in some ethnic traditions, such as klezmer music.

Classical music

A pair of Boehm-System Soprano Clarinets — one in B♭ and one in A.

In classical music, clarinets are part of standard orchestral instrumentation, which frequently includes two clarinetists playing individual parts — each player is usually equipped with a pair of standard clarinets in B♭ and A (see above) and clarinet parts commonly alternate between B♭ and A instruments several times over the course of a piece or even, less commonly, of a movement (e.g. 1st movement Brahms 3rd symphony).[39] Clarinet sections grew larger during the last few decades of the 19th century, often employing a third clarinetist, an E♭ or a bass clarinet. In the 20th century, composers such as Igor Stravinsky, Richard Strauss, Gustav Mahler and Olivier Messiaen enlarged the clarinet section on occasion to up to nine players, employing many different clarinets including the E♭ or D soprano clarinets, basset horn, alto clarinet, bass clarinet and/or contrabass clarinet.

This practice of using a variety of clarinets to achieve coloristic variety was common in 20th century music and continues today. However, many clarinetists and conductors prefer to play parts originally written for obscure instruments on B♭ or E♭ clarinets, which are often of better quality and more prevalent and accessible.[39]

The clarinet is widely used as a solo instrument. The relatively late evolution of the clarinet (when compared to other orchestral woodwinds) has left solo repertoire from the Classical period and later, but few works from the Baroque era.[2] Many clarinet concertos have been written to showcase the instrument, with the concerti by Mozart, Copland and Weber being well known.

Many works of chamber music have also been written for the clarinet. Common combinations are:

- Clarinet and piano (including clarinet sonatas)[40]
- Clarinet, piano and another instrument (for example, string instrument or voice)[2]
- Clarinet quartet: various combinations including four B♭ clarinets,[41] three B♭ clarinets and bass clarinet, two B♭ clarinets, alto clarinet and bass, and other possibilities such as the use of a basset horn, especially in European classical works.[42] [43]
- Clarinet quintet, generally made up of a clarinet plus a string quartet.[44]
- Wind quintet, consists of flute, oboe, clarinet, bassoon, and horn.[45]
- Trio d'anches, or *trio of reeds* consists of oboe, clarinet, and bassoon.[46]
- Wind octet, consists of pairs of oboes, clarinets, bassoons, and horns.[46]

Concert bands

In wind bands, clarinets are a central part of the instrumentation, occupying the same space (and often playing the same notes) in bands that the strings do in orchestras. Bands usually include several B♭ clarinets, divided into sections each consisting of two or three clarinetists playing the same part. There is almost always an E♭ clarinet part and a bass clarinet part, usually doubled.[47] Alto, contra-alto, and contrabass clarinets are sometimes used as well, and, rarely, a piccolo A♭ clarinet.[47]

Jazz

The clarinet was a central instrument in early jazz starting in the 1910s and remained popular in the United States through the big band era into the 1940s.[2] Larry Shields, Ted Lewis, Jimmie Noone and Sidney Bechet were influential in early jazz. The B♭ soprano was the most common instrument, but a few early jazz musicians such as Louis Nelson Delisle and Alcide Nunez preferred the C soprano, and many New Orleans jazz brass bands have used E♭ soprano.[2]

Dr Michael White (front right) plays clarinet at a jazz funeral in Treme, New Orleans, Louisiana.

Swing clarinetists such as Benny Goodman, Artie Shaw, and Woody Herman led successful and popular big bands and smaller groups from the 1930s onward.[48] With the decline of the big bands' popularity in the late 1940s, the clarinet faded from its prominent position in jazz, though a few players (John Carter, Buddy DeFranco, Eric Dolphy, Jimmy Giuffre, Perry Robinson, Theo Jorgensmann and others) used clarinet in bebop and free jazz. The clarinet's place in the jazz ensemble was usurped by the saxophone, which projects a more powerful sound and uses a less complicated fingering system.[49]

During the 1950s and 1960s, Britain underwent a surge in the popularity of traditional jazz. During this period, a British clarinetist named Acker Bilk became popular, founding his own ensemble in 1956.[50] Bilk had a string of successful records, including the popular "Stranger on the Shore".

In the U.S., the instrument has seen something of a resurgence since the 1980s, with Eddie Daniels, Don Byron, and Marty Ehrlich and others playing the clarinet in more contemporary contexts.[2] The instrument remains common in Dixieland music; Pete Fountain is one of the best known performers in this genre.[51] Bob Wilber, active since the 1950s, is a more eclectic jazz clarinetist, playing in several classic jazz styles.[52] Filmmaker Woody Allen is a

notable jazz clarinet enthusiast, and performs New Orleans-style jazz regularly with his quartet in New York.[53] Jean-Christian Michel, French composer and clarinetist has initiated a jazz-classical cross-over on the clarinet with the drummer Kenny Clarke. See also Gilad Atzmon whose 21st century jazz style has been described as bebop/hard bop, with forays into free jazz and swing, influenced by Arabic music.

In Canada, John Malmstrom [54] performs in various mid-20th-century styles as well as writes original jazz compositions featuring clarinet and saxophone.

Other genres

In rock the clarinet is used very rarely.

Clarinets also feature prominently in klezmer music, which entails a distinctive style of playing.[55] The use of quarter-tones requires a different embouchure.[2] Some klezmer musicians prefer Albert system clarinets.[15]

The popular Brazilian music styles of choro and samba use the clarinet.[56] Prominent contemporary players include Paulo Moura, Naylor 'Proveta' Azevedo, Paulo Sérgio dos Santos and Paquito D'Rivera.

The clarinet is prominent in Bulgarian wedding music, an offshoot of Roma/Romani traditional music.[57] Ivo Papazov is a well-known clarinetist in this genre. In Moravian dulcimer bands, the clarinet is usually the only wind instrument among string instruments.[58]

In the Republic of Macedonia, old-town folk music -called chalgija ("чалгија"), the clarinet has the most important role in wedding music; clarinet solos mark the high point of dancing euphoria.[59] One of the most renowned Macedonian clarinet players is Tale Ognenovski, who gained worldwide fame for his virtuosity.[60]

In Greece the clarinet (usually referred to as "κλαρίνο" - "clarino") is prominent in traditional music, especially in central, northwest and northern Greece (Thessaly, Epirus and Macedonia).[61] The double-reed zurna was the dominant woodwind instrument before the clarinet arrived in the country, although many Greeks regard the clarinet as a native instrument.[15] Traditional dance music, wedding music and laments include a clarinet soloist and quite often improvisations.[61] Petroloukas Chalkias is a famous clarinetist in this genre.

The instrument is equally famous in Turkey, especially the soprano clarinet in G. The soprano clarinet crossed via Turkey to Arabic music, where it is widely used in Arabic pop, especially if the intention of the arranger is to imitate the Turkish style.[15]

Turkish clarinet

Groups of clarinets


Contrabass and contra-alto clarinets

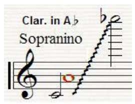
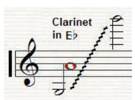
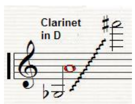
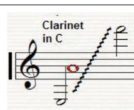
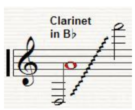
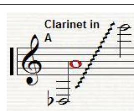
Groups of clarinets playing together have become increasingly popular among clarinet enthusiasts in recent years. Common forms are:

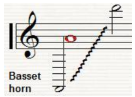
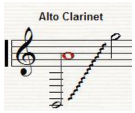
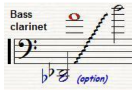
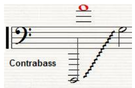
- Clarinet choir, which features a large number of clarinets playing together, usually involves a range of different members of the clarinet family (see Extended family of clarinets). The homogeneity of tone across the different members of the clarinet family produces an effect with some similarities to a human choir.[62]
- Clarinet quartet, usually three B♭ sopranos and one B♭ bass, or two B♭, an E♭ Alto Clarinet, and a B♭ Bass Clarinet, or sometimes four B♭ sopranos.[63]

Clarinet choirs and quartets often play arrangements of both classical and popular music, in addition to a body of literature specially written for a combination of clarinets by composers such as Arnold Cooke, Alfred Uhl, Lucien Caillet and Václav Nelhýbel.[64]

Extended family of clarinets

There is a family of many differently pitched clarinet types, some of which are very rare. The following are the most important sizes, from highest to lowest:

Name	Key	Commentary	Range (concert)
Piccolo clarinet	A♭	Now rare, used for Italian military music and some contemporary pieces for its sonority;[65]	
Sopranino clarinet	E♭	Characteristic timbre, used in concert band repertoire because its tonality is considered "compatible" with other instruments, especially those in B♭.[2]	
Sopranino clarinet	D	Obscure because of its limited repertoire in Western music.[2]	
Soprano clarinet	C	Rare because its timbre is considered too bright.[66]	
Soprano clarinet	B♭	The most common type: used in most styles of music.[2]	
Soprano clarinet	A	Has a richer sound than B♭, frequently used in orchestral and chamber music.[2]	
Basset clarinet	A	Clarinet in A extended to a low C; used primarily to play Classical-era music.[67] Mozart's Clarinet Concerto was written for this instrument, though it is frequently played in a version for the ordinary A clarinet. Basset clarinets in Bb also exist; this instrument is required to play the obbligato to the aria "Parto, parto" in Mozart's La Clemenza di Tito.	

Basset-horn	F	Similar in appearance to the alto, but differs in that it is pitched in F, has an extended range to low C, and has a narrower bore on most models. Mozart's Clarinet Concerto was originally sketched out as a concerto for basset horn in G. Rarely used today.	
Alto clarinet	E♭	Used in chamber music and wind ensembles.[3]	
Bass clarinet	B♭	Used in contemporary music, concert band and jazz; sometimes used in orchestral music.[2]	
Contra-alto clarinet (also called E♭ Contrabass Clarinet)	EE♭	Used in clarinet choirs.[2]	
Contrabass clarinet (also called B♭ Subcontrabass or Double-bass Clarinet)	BB♭	Used in clarinet choirs and sometimes in orchestras and wind ensembles.[2]	

Experimental EEE♭ and BBB♭ octocontra-alto and octocontrabass clarinets have also been built.[68] There have also been soprano clarinets in C, A, and B♭ with curved barrels and bells marketed under the names Saxonette, Claribel, and Clariphon.

Notes

[1] Definition of Clarinet (http://www.thefreedictionary.com/licorice+stick) at the Free Dictionary by Farlex. Retrieved April 2010.

[2] Lawson, Colin James. *The Cambridge companion to the clarinet*. Cambridge University Press, 1995.

[3] Pino D. *The clarinet and clarinet playing*. Dover Publications, 1998.

[4] Richards, E. Michael. "The Clarinet of the Twenty-First Century" (http://userpages.umbc.edu/~emrich/chapter7.html). . Retrieved 2009-07-19.

[5] Reed, Alfred. "The Composer and the College Band". *Music Educators Journal*, Vol. **48**, No. 1 (September–October 1961), pp. 51–53

[6] Cockshott, Gerald; D. K. Dent, Morrison C. Boyd and E. J. Moeran (October 1941). "English Composer Goes West". *The Musical Times* (Musical Times Publications Ltd.) **82** (1184): 376–378. doi:10.2307/922164. JSTOR 922164.

[7] Shigeru Yamaryo. Yamaha Corporation. Key mechanism for a bass clarinet. Patent number: 4809580. Filing date: 16 October 1987. Issue date: 7 March 1989

[8] Cailliet, Lucien (1960). *The Clarinet and Clarinet Choir*. New York: G. Leblanc Corp.

[9] Lowry, Robert (1985). *Practical Hints on Playing the B-Flat Clarinet*. Alfred Publishing.

[10] Ridenour, Thomas (2000). *Clarinet Fingerings*. p. 42.

[11] Sadie, Stanley (1984). *New Grove Dictionary of Musical Instruments*. Macmillan Press. p. 391. ISBN 0943818052.

[12] Randell, F. Geoffrey (1971). *The Clarinet (Third Edition)*. pp. 11–15.

[13] Jenkins, Martin; Sara Oldfield and Tiffany Aylett (2002). "International Trade in African Blackwood" (http://www.globaltrees.org/downloads/IntTradeAfBWood.pdf). Fauna & Flora International. . Retrieved 2009-07-19.

[14] "The Silver Clarinet Story" (http://www.silver-clarinet.com/). . Retrieved 2009-07-19.

[15] Hoeprich, Eric (2008). *The Clarinet*. Yale University Press. ISBN 0300102828.

[16] "Greenline Clarinets" (http://www.buffet-crampon.com/en/instruments.php?mode=productDetails&pid=108.). Buffet Crampon. . Retrieved 2007-03-16.

[17] "Materials" (http://www.hansonclarinets.com/clarinet making/Materials.html). Hanson Clarinets. . Retrieved 2007-06-22.; Ridenour, Tom. "The Grenadilla Myth" (http://www.ridenourclarinetproducts.com/grenadillamyth.htm). . Retrieved 2007-03-16.

[18] Pinksterboer, Hugo (2001). *Tipbook Clarinet*. Hal Leonard Corporation. ISBN 1858287537.

[19] Obataya E, Norimoto M. "Acoustic properties of a reed (*Arundo donax* L.) used for the vibrating plate of a clarinet". *J. Acoust. Soc. Am.* Volume **106**, Issue 2, pp. 1106–1110 (August 1999)

[20] Baines, Anthony. *Woodwind instruments and their history*. Dover Publications, 1991.

[21] Intravaia, Lawrence J; Robert S. Resnick (Spring 1968). "A Research Study of a Technique for Adjusting Clarinet Reeds". *Journal of Research in Music Education* (MENC) **16** (1): 45–58. doi:10.2307/3344436. JSTOR 3344436.

[22] "The bore". http://www.the-clarinets.net/clarinet-bore.html.Accessed 2009-7-2. Archived (http://web.archive.org/20080804090450/http://www.the-clarinets.net/clarinet-bore.html) August 4, 2008 at the Wayback Machine.

[23] Ridley, E.A.K. (September 1986). "Birth of the 'Boehm' Clarinet". *The Galpin Society Journal* **39**: 68–76. doi:10.2307/842134. JSTOR 842134.

[24] Horvath, Janet (September 2001). "An Orchestra Musician's Perspective on 20 Years of Performing Arts Medicine". *Medical Problems of Performing Artists* **16** (3): 102.
[25] "Clarinet acoustics: an introduction". University of New South Wales. http://www.phys.unsw.edu.au/jw/clarinetacoustics.html. Retrieved 2009-7-2.
[26] Synthesis of acoustics (http://www.phys.unsw.edu.au/~jw/clarinetacoustics.html#Clarinet) University of New South Wales.
[27] Cavanagh, Lynn. "A brief history of the establishment of international standard pitch a=440 hertz" (http://www.wam.hr/Arhiva/US/Cavanagh_440Hz.pdf). . Retrieved 2009-07-20.
[28] Baines, Anthony. *Woodwind instruments and their history*. W.W. Norton & Co, 1957
[29] Gibson, Lee. "Fundamentals of Acoustical Design of the Soprano Clarinet". Music Educators Journal, Vol. 54, No. 6 (Feb., 1968), pp. 113–115
[30] Drushler, P (1978). "The clarinet vibrato". *Woodwind Anthology* (Illinois).
[31] Heaton, Roger. *The Contemporary Clarinet*. doi:10.2277/0521476682. In Lawson (ed.), Colin (1995). *The Cambridge Companion to the Clarinet*. Cambridge University Press. pp. 174–175.
[32] Karp, Cary (1986). "The early history of the clarinet and chalumeau". *Early Music* (Oxford University Press) **14** (4): 545–551. doi:10.1093/earlyj/14.4.545.
[33] Hoeprich, T Eric. "A Three-Key Clarinet by J.C. Denner". *The Galpin Society Journal*, Vol. 34, (Mar., 1981), pp. 21–32
[34] Hacker, Alan. "Mozart and the Basset Clarinet". *The Musical Times*, Vol. **110**, No. 1514 (Apr., 1969), pp. 359–362.
[35] Bray, Erin (2004-11-16). "The clarinet history" (http://hem.passagen.se/eriahl/history.htm). *The clarinet family*. . Retrieved 2009-07-20.
[36] Clarinet History, 1812 (http://www.jlpublishing.com/ClarinetHistory.htm).
[37] Ridley, EAK. "Birth of the 'Boehm' Clarinet". *The Galpin Society Journal*, Vol. **39**, (Sep., 1986), pp. 68–76
[38] Longyear, RM. "Clarinet Sonorities in Early Romantic Music". The Musical Times, Vol. 124, No. 1682 (Apr., 1983), pp. 224–226
[39] Del Mar, Norman. *Anatomy of the Orchestra*. University of California Press, 1983.
[40] Burnet C. Tuthill, "Sonatas for Clarinet and Piano: Annotated Listings", *Journal of Research in Music Education,* Vol. 20, No. 3. (Autumn, 1972), pp. 308–328.
[41] *Symphony* **5–6**. 1950. "A clarinet quartet could be composed of four soprano clarinets and be quite effective".
[42] Weerts, Richard K. (Autumn, 1964). "The Clarinet Choir". *Journal of Research in Music Education* (MENC) **12** (3): 227–230. doi:10.2307/3343790. JSTOR 3343790.
[43] Lawson, Colin (1995). *The Cambridge companion to the clarinet* (http://books.google.com/books?id=P4Jvai9yPqgC&pg=PA58). Cambridge companions to music. Cambridge University Press. p. 58. ISBN 0521476682. . "To find a basset horn as part of the instrumentation of a clarinet quartet, quintet, etc., written by a European composer is quite usual, whilst in the USA today's composers rarely use it even in the orchestra."
[44] Street, Oscar W. (1915). "The Clarinet and Its Music". *Journal of the Royal Musical Association* (1915: Royal Musical Association) **42** (1): 89–115. doi:10.1093/jrma/42.1.89.
[45] Suppan, Wolfgang. 2001. "Wind Quintet." The New Grove Dictionary of Music and Musicians, ed. S. Sadie and J. Tyrrell. London: Macmillan.
[46] Costa, Anthony. "A BIBLIOGRAPHY OF CHAMBER MUSIC AND DOUBLE CONCERTI LITERATURE FOR OBOE AND CLARINET". Ohio State University. Dissertation. 2005.
[47] Erickson, Frank. *Arranging for the Concert Band*. Alfred Publishing, 1985.
[48] Schuller, Gunther. *The swing era*. Oxford University Press, 1989.
[49] John Carter's Case For The Clarinet (http://www.nytimes.com/1981/07/05/arts/john-carter-s-case-for-the-clarinet.html) by Robert Palmer, Published: July 5, 1981, New York Times. Retrieved April 2010.
[50] Kaufman, Will; Heidi Slettedahl Macpherson (2005). *Britain and the Americas*. ABC-CLIO. ISBN 1851094318.
[51] Compagno, Nick. "A Closer Walk with Pete Fountain" (http://www.experienceneworleans.com/pete.html). . Retrieved 2009-07-20.
[52] Wilber, Bob (1988). *Music Was Not Enough*. Oxford University Press. ISBN 0333444183.
[53] "New Orleans Trombone, Jerry Zigmont - Jazz Trombone, Eddy Davis & His New Orleans Jazz Band featuring Woody Allen, Cafe Carlyle, Woody Allen Band" (http://www.woodyallenband.com). . Retrieved 2008-01-17.
[54] http://www.johnmalmstrom.com
[55] Slobin, Mark (1984). "Klezmer Music: An American Ethnic Genre". *Yearbook for Traditional Music* (International Council for Traditional Music) **16**: 34–41. doi:10.2307/768201. JSTOR 768201.
[56] Livingston-Isenhour, Tamara Elena; Thomas George Caracas Garcia (2005). *Choro*. Indiana University Press. ISBN 0253345413.
[57] Rowlett, M (2001). *The Clarinet in Bulgarian Wedding Music*. Florida State University.
[58] Broughton, Simon; Mark Ellingham, Richard Trillo, Orla Duane, Vanessa Dowell (1999). *World Music*. Rough Guides. ISBN 185828113X.
[59] "Tale Ognenovski and Chalgiite MRTV - Nevestinsko oro" (http://www.youtube.com/watch?v=UEIkphIDuYM). . Retrieved 2010-01-29.
[60] "Tale Ognenovski, Musical Genius, Clarinetist And Composer" (http://www.taleognenovski.com.mk/). . Retrieved 2009-07-21.
[61] Pappas, John (1998). "Greek Folk Instrument Groups" (http://www.greekfolkmusicanddance.com/instrumentation.php). . Retrieved 2009-07-21.
[62] Weerts, Richard (1964). "The Clarinet Choir". *Journal of Research in Music Education* (MENC) **12** (3): 227–230. doi:10.2307/3343790. JSTOR 3343790.

[63] Seay, Albert E. (September–October 1948). "Modern Composers and the Wind Ensemble". *Music Educators Journal* (MENC) **35** (1): 27–28. doi:10.2307/3386973. JSTOR 3386973.
[64] "Clarinet Quartet Project" (http://www.clarinetinstitute.com/CI Quartet Project.htm). Clarinet Institute. . Retrieved 2009-07-21.
[65] Clarinette en la♭ (http://www.clarinettes.net/Famille.htm#Sopranino)
[66] Clarinette en Ut (http://www.clarinettes.net/Famille.htm#Ut)
[67] Albert R. Rice, The Clarinet in the Classical Period. Oxford: Oxford University Press, 2003.
[68] Green, Grant D. (2005). "Octocontrabass & Octocontralto Clarinets" (http://www.contrabass.com/pages/octobass.html). . Retrieved 2009-07-21.

Further reading

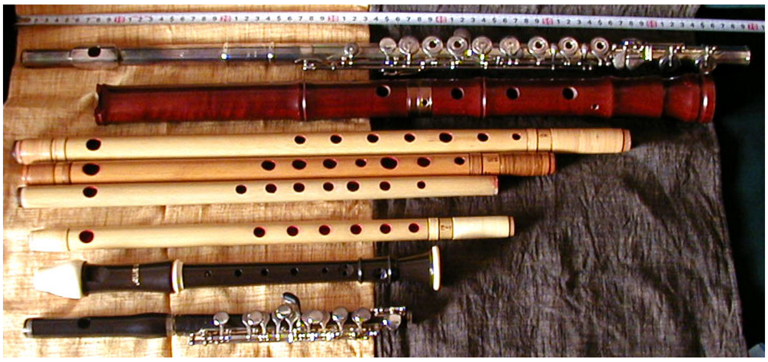
- Nicholas Bessaraboff, *Ancient European Musical Instruments.* Boston: Harvard University Press, 1941.
- "Woodwind Instruments and Their History" by Anthony Baines, Dover Publishing.
- Jack Brymer, *Clarinet*. (Yehudi Menuhin Music Guides) Hardback and paperback, 296 pages, Kahn & Averill. ISBN 1-871082-12-9.
- David Pino, *The Clarinet and Clarinet Playing.* Providence: Dover Pubns, 1998, 320 p.; ISBN 0-486-40270-3.
- F. Geoffrey Rendall, *The Clarinet.* Second Revised Edition. London: Ernest Benn Limited, 1957.
- Cyrille Rose, *Artistic Studies, Book 1.* ed. David Hite. San Antonio: Southern Music, 1986.
- Nicholas Shackleton, "Clarinet", *Grove Music Online*, ed. L. Macy (accessed 21 February 2006), grovemusic.com (http://www.grovemusic.com/) (subscription access).
- Buffet Crampon Greenline website (http://www.buffet-crampon.com/en/instruments.php?mode=productDetails&pid=108)
- Jennifer Ross, "Clarinet", "Ohio: Hardcover Printing Press, 1988.
- Fabrizio Meloni, *Il Clarinetto*, ill., 299 pages, Zecchini Editore, zecchini.com (http://www.zecchini.com/) Italy, 2002, ISBN 88-87203-03-2.
- Bărbuceanu Valeriu, "Dictionary of musical instruments", Second Revised Edition, Teora Press, Bucharest, 1999.
- "Fundamentals of Musical Acoustics" by Arthur H. Benade, Dover Publishing.
- SELMER Paris : the clarinet family (http://www.selmer.fr/instruinfo.php?page=GEN&famille=SELMER CLAR)

External links

- The International Clarinet Association (http://www.clarinet.org)
- The-Clarinets.net - Comprehensive clarinet info-site, non-commercial (http://www.the-clarinets.net)
- Clarinets in the Edinburgh University Collection of Historic Musical Instruments (http://www.music.ed.ac.uk/euchmi/ugw/ugwf1x.html)
- Clarinet acoustics (http://www.phys.unsw.edu.au/~jw/clarinetacoustics.html)
- UNM List of Clarinet Repertoire (http://music.unm.edu/department_areas/woodwind/clarinet/repertoire.htm)
- Clarinet Fingering Chart (http://www.woodwind.org/clarinet/Study/FingeringCharts/bbfinger.html)
- Interactive Clarinet Fingering Trainer (http://www.clarinettrainer.com/)
- Comprehensive list of fingerings for Kinderklarinettes and Boehm-, Albert-, and Oehler-system clarinets (http://www.wfg.woodwind.org/clarinet/)
- Professional Orchestral Clarinetists Worldwide List (http://mytempo.com/orchestra.htm)

Flute

The **flute** is a musical instrument of the woodwind family. Unlike woodwind instruments with reeds, a flute is an aerophone or reedless wind instrument that produces its sound from the flow of air across an opening. According to the instrument classification of Hornbostel-Sachs, flutes are categorized as edge-blown aerophones.



A selection of flutes from around the world

A musician who plays the flute can be referred to as a *flute player*, a *flautist*, a *flutist*, or less commonly a *fluter*.

Aside from the voice, flutes are the earliest known musical instruments. A number of flutes dating to about 40,000 to 35,000 years ago have been found in the Swabian Alb region of Germany. These flutes demonstrate that a developed musical tradition existed from the earliest period of modern human presence in Europe.[1]

History

Further information: paleolithic flutes and prehistoric music

The oldest flute ever discovered may be a fragment of the femur of a juvenile cave bear, with two to four holes, found at Divje Babe in Slovenia and dated to about 43,000 years ago. The authenticity of this fact, however, is often disputed.[2] [3] In 2008 another flute dated back to at least 35,000 years ago was discovered in Hohle Fels cave near Ulm, Germany.[4] The five-holed flute has a V-shaped mouthpiece and is made from a vulture wing bone. The researchers involved in the discovery officially published their findings in the journal *Nature*, in August 2009.[5] The discovery is also the oldest confirmed find of any musical instrument in history.[6] The flute, one of several found, was found in the Hohle Fels cavern next to the Venus of Hohle Fels and a short distance from the oldest known human carving.[7] On announcing the discovery, scientists suggested that the "finds demonstrate the presence of a well-established musical tradition at the time when modern humans colonized Europe".[8] Scientists have also suggested that the discovery of the flute may help to explain "the probable behavioural and cognitive gulf between" Neanderthals and early modern human.[6]

Chinese women playing flutes, from the 12th-century Song Dynasty remake of the *Night Revels of Han Xizai*, originally by Gu Hongzhong (10th century)

A three-holed flute, 18.7 cm long, made from a mammoth tusk (from the Geißenklösterle cave, near Ulm, in the southern German Swabian Alb and dated to 30,000 to 37,000 years ago)[9] was discovered in 2004, and two flutes made from swan bones excavated a decade earlier (from the same cave in Germany, dated to circa 36,000 years ago) are among the oldest known musical instruments.

Playable 9000-year-old Gudi (literally, "bone flute"), made from the wing bones of red-crowned cranes, with five to eight holes each, were excavated from a tomb in Jiahu[10] in the Central Chinese province of Henan.[11]


Panflute players. *Cantigas de Santa Maria*, mid-13th century, Spain

The earliest extant Chinese transverse flute is a *chi* (篪) flute discovered in the Tomb of Marquis Yi of Zeng at the Suizhou site, Hubei province, China. It dates from 433 BC, of the later Zhou Dynasty.[12] It is fashioned of lacquered bamboo with closed ends and has five stops that are at the flute's side instead of the top. Chi flutes are mentioned in Shi Jing, compiled and edited by Confucius, according to tradition.

The Bible, in Genesis 4:21, cites Jubal as being the "father of all those who play the *ugab* and the *kinnor*". The former Hebrew term refers to some wind instrument, or wind instruments in general, the latter to a stringed instrument, or stringed instruments in general. As such, Jubal is regarded in the Judeo-Christian tradition as the inventor of the flute (a word used in some translations of this biblical passage). Some early flutes were made out of tibias (shin bones). The flute has also always been an essential part of Indian culture and mythology,[13] and the cross flute believed by several accounts to originate in India[14] [15] as Indian literature from 1500 BCE has made vague references to the cross flute.[16]

Flute acoustics

A flute produces sound when a stream of air directed across a hole in the instrument creates a vibration of air at the hole.[17] [18]

The air stream across this hole creates a Bernoulli, or siphon. This excites the air contained in the usually cylindrical resonant cavity within the flute. The player changes the pitch of the sound produced by opening and closing holes in the body of the instrument, thus changing the effective length of the resonator and its corresponding resonant frequency. By varying the air pressure, a flute player can also change the pitch of a note by causing the air in the flute to resonate at a harmonic other than the fundamental frequency without opening or closing any holes.

To be louder, a flute must use a larger resonator, a larger air stream, or increased air stream velocity. A flute's volume can generally be increased by making its resonator and tone holes larger. This is why a police whistle, a form of flute, is very wide for its pitch, and why a pipe organ can be far louder than a concert flute: a large organ pipe can contain several cubic feet of air, and its tone hole may be several inches wide, while a concert flute's air stream measures a fraction of an inch across.

The air stream must be directed at the correct angle and velocity, or else the air in the flute will not vibrate. In fippled or ducted flutes, a precisely formed and placed windway will compress and channel the air to the labium ramp edge across the open window. In the pipe organ, this air is supplied by a regulated blower.

In non-fipple flutes, the air stream is shaped and directed by the player's lips, called the embouchure. This allows the player a wide range of expression in pitch, volume, and timbre, especially in comparison to fipple/ducted flutes. However, it also makes an end blown flute or transverse flute considerably more difficult for a beginner to produce a full sound on than a ducted flute, such as the recorder. Transverse and end-blown flutes also take more air to play, which requires deeper breathing and makes circular breathing a considerably trickier proposition.

Generally, the quality called timbre or "tone colour" varies because the flute can produce harmonics in different proportions or intensities. The tone color can be modified by changing the internal shape of the bore, such as the conical taper, or the diameter-to-length ratio. A harmonic is a frequency that is a whole number multiple of a lower register, or "fundamental" note of the flute. Generally the air stream is thinner (vibrating in more modes), faster

(providing more energy to excite the air's resonance), and aimed across the hole less deeply (permitting a more shallow deflection of the air stream) in the production of higher harmonics or upper partials.

Head joint geometry appears particularly critical to acoustic performance and tone,[19] but there is no clear consensus on a particular shape amongst manufacturers. Acoustic impedance of the embouchure hole appears the most critical parameter.[20] Critical variables affecting this acoustic impedance include: chimney length (hole between lip-plate and head tube), chimney diameter, and radii or curvature of the ends of the chimney and any designed restriction in the "throat" of the instrument, such as that in the Japanese Nohkan Flute.

A study in which professional players were blindfolded could find no significant differences between instruments made from a variety of different metals.[21] In two different sets of blind listening, no instrument was correctly identified in a first listening, and in a second, only the silver instrument was identified. The study concluded that there was "no evidence that the wall material has any appreciable effect on the sound color or dynamic range of the instrument".

Categories of flute

Playing the *zampoña*, a Pre-Inca instrument and type of pan flute.

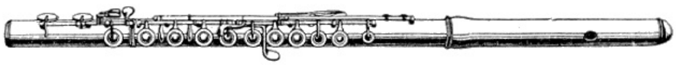
In its most basic form, a flute can be an open tube which is blown like a bottle. There are several broad classes of flutes. With most flutes, the musician blows directly across the edge of the mouthpiece. However, some flutes, such as the whistle, gemshorn, flageolet, recorder, tin whistle, tonette, fujara, and ocarina have a duct that directs the air onto the edge (an arrangement that is termed a "fipple"). These are known as **fipple flutes**. The fipple gives the instrument a distinct timbre which is different from non-fipple flutes and makes the instrument easier to play, but takes a degree of control away from the musician.

Another division is between **side-blown** (or **transverse**) flutes, such as the Western concert flute, piccolo, fife, dizi, and bansuri; and **end-blown flutes**, such as the ney, xiao, kaval, danso, shakuhachi, Anasazi flute, and quena. The player of a side-blown flute uses a hole on the side of the tube to produce a tone, instead of blowing on an end of the tube. End-blown flutes should not be confused with fipple flutes such as the recorder, which are also played vertically but have an internal duct to direct the air flow across the edge of the tone hole.

Flutes may be open at one or both ends. The ocarina, xun, pan pipes, police whistle, and bosun's whistle are closed-ended. Open-ended flutes such as the concert flute and the recorder have more harmonics, and thus more flexibility for the player, and brighter timbres. An organ pipe may be either open or closed, depending on the sound desired.

Flutes can be played with several different air sources. Conventional flutes are blown with the mouth, although some cultures use nose flutes. The flue pipes of organs, which are acoustically similar to duct flutes, are blown by bellows or fans.

The Western concert flutes



An illustration of a Western concert flute

The Western concert flute, a descendant of the 19th-century German flute, is a transverse flute that is closed at the top. An

embouchure hole is positioned near the top, across and into which the player blows. The flute has circular tone holes, larger than the finger holes of its baroque predecessors. The size and placement of tone holes, the key mechanism, and the fingering system used to produce the notes in the flute's range were evolved from 1832 to 1847 by Theobald Boehm, and greatly improved the instrument's dynamic range and intonation over those of its predecessors.[22] With some refinements (and the rare exception of the Kingma system and other custom adapted fingering systems), Western concert flutes typically conform to Boehm's design, known as the Boehm system. Beginner's flutes are normally made of nickel silver or brass which is silver plated, while professionals use solid silver, gold, and sometimes platinum instruments. There are also modern wooden bodies instruments usually with silver or gold keywork. The wood is usually African Blackwood.

The standard concert flute is pitched in the key of C and has a range of three octaves starting from middle C (or one half-step lower, when a B foot is attached to the instrument). This means that the concert flute is one of the highest common orchestral instruments, with the exception of the piccolo, which plays an octave higher. G alto and C bass flutes are used occasionally, and are pitched a perfect fourth and an octave below the concert flute, respectively. Parts are written for alto flute more frequently than for bass . The contrabass, double contrabass, and hyperbass are other rare forms of the flute pitched two, three, and four octaves below middle C respectively.

Other sizes of flutes and piccolos are used from time to time. A rarer instrument of the modern pitching system is the treble G flute. Instruments made according to an older pitch standard, used principally in wind-band music, include Db piccolo, Eb soprano flute (the primary instrument, equivalent to today's concert C flute), F alto flute, and Bb bass flute.

The Indian bamboo flute

A Carnatic eight-holed bamboo flute

An eight-holed classical Indian bamboo flute mainly used for Carnatic music

The bamboo flute is an important instrument in Indian classical music, and developed independently of the Western flute. The Hindu God Krishna is traditionally considered a master of the Bansuri (see below). The Indian flutes are very simple compared to the Western counterparts; they are made of bamboo and are keyless.[23]

Pannalal Ghosh, a legendary Indian flutist, was the first to transform a tiny folk instrument to a bamboo flute (32 inches long with seven finger holes) suitable for playing traditional Indian classical music, and also to bring to it the stature of other classical music instruments. The extra hole permitted *madhyam* to be played, which facilitates the *meends* (like M N, P M and M D) in several traditional ragas.

Pandit Raghunath Prasanna developed various techniques in the realm of flute playing so as to faithfully reproduce the subtleties and nuances of the Indian classical music. In fact, he was responsible to provide a strong base to his Gharana by training his own family members. Disciples of the family like Pt. Bhola nath Prasanna, Pt. Hari Prasad Chaurasia, Pt. Rajendra Prasanna globally known for their melodious music.

Indian concert flutes are available in standard pitches. In Carnatic music, the pitches are referred by numbers such as (assuming C as


A bansuri being played by an Indian classical music artist.

the tonic) 1 (for C), 1½ (C#), 2 (D), 2½ (D#), 3 (E), 4 (F), 4½ (F#), 5 (G), 5½ (G#), 6 (A), 6½ (A#) and 7 (B). However, the pitch of a composition is itself not fixed and hence any of the flutes may be used for the concert (as long as the accompanying instruments, if any, are tuned appropriately) and is largely left to the personal preference of the artist.

Two main varieties of Indian flutes are currently used. The first, the Bansuri, has six finger holes and one embouchure hole, and is used predominantly in the Hindustani music of Northern India. The second, the Venu or *Pullanguzhal*, has eight finger holes, and is played predominantly in the Carnatic music of Southern India. Presently, the eight-holed flute with cross-fingering technique is common among many Carnatic flutists. Prior to this, the South Indian flute had only seven finger holes, with the fingering standard developed by Sharaba Shastri, of the Palladam school, at the beginning of the 20th century.[24]

The quality of the flute's sound depends somewhat on the specific bamboo used to make it, and it is generally agreed that the best bamboo grows in the Nagercoil area in South India.[25]


Temple car carving of Krishna playing flute , suchindram ,tamil nadu

Chinese flute

Chinese flute are called [dizi] (笛子). There are many varieties of dizi with different sizes, structures (with or without resonance membrane) and number of holes (from 6 to 11) and intonations (playing in different keys) in China. Most are made of bamboo, but can come in wood, jade, bone, and iron. One peculiar feature about Chinese flute is the use of a resonance membrane mounting on one of the holes which vibrates with the air column inside the tube. It gives the flute a bright sound. Commonly seen flutes in modern Chinese orchestra are bangdi (梆笛), qudi (曲笛) , xindi (新笛) , dadi (大笛). The bamboo flute playing vertically is called “xiao”(簫) which is a different category of wind instrument in China.

Japanese flute

The Japanese flute, called the fue **Fue** (笛, hiragana: ふえ), encompasses a large number of musical flutes from Japan, both of the end-blown and transverse varieties.

Sring

The sring (also called *blul*) is a relatively small, end-blown flute with a nasal tone quality[26] and the pitch of a piccolo, found in the Caucasus region of Eastern Armenia. It is made of wood or cane, usually with seven finger holes and one thumb hole,[26] producing a diatonic scale. The sring is used by shepherds to play various signals and tunes connected with their work, and also lyrical love songs called *chaban bayaty*, as well as programmatic pieces. The sring is also used in combination with the *def* and the dohl to provide music for dancing. One Armenian musicologist believes the sring to be the most characteristic of national Armenian instruments.[27]

References

[1] Wilford, John N. (June 24, 2009). "Flutes Offer Clues to Stone-Age Music" (http://www.nytimes.com/2009/06/25/science/25flute.html). *The New York Times* **459** (7244): 248–52. doi:10.1038/nature07995. PMID 19444215. . Retrieved June 29, 2009.. Citation on p. 248.

[2] Tenenbaum, David (June 2000). "Neanderthal jam" (http://whyfiles.org/114music/4.html). *The Why Files*. University of Wisconsin, Board of Regents. . Retrieved 14 March 2006.

[3] Flute History (http://cogweb.ucla.edu/ep/FluteDebate.html), UCLA. Retrieved June 2007.

[4] BBC: 'Oldest musical instrument' found (http://news.bbc.co.uk/2/hi/science/nature/8117915.stm)

[5] Nicholas J. Conard, Maria Malina, and Susanne C. Münzel (August 2009). "New Flutes Document the Earliest Musical Tradition in Southwestern Germany". *Nature* **460** (7256): 737–40. Bibcode 2009Natur.460..737C. doi:10.1038/nature08169. ISSN 0028-0836. PMID 19553935.

[6] "'Oldest musical instrument' found" (http://news.bbc.co.uk/1/hi/sci/tech/8117915.stm). BBC news. 2009-06-25. . Retrieved 2009-06-26.

[7] "Music for cavemen" (http://cosmiclog.msnbc.msn.com/archive/2009/06/24/1976108.aspx). MSNBC. 2009-06-24. . Retrieved 2009-06-26.

[8] "Flutes Offer Clues to Stone-Age Music" (http://www.nytimes.com/2009/06/25/science/25flute.html?_r=1&partner=rss&emc=rss). The New York Times. 2009-06-24. . Retrieved 2009-06-26.

[9] "Archeologists discover ice age dwellers' flute" (http://www.cbc.ca/arts/story/2004/12/30/flute-prehistoric041230.html). *CBC Arts* (Canadian Broadcasting Corporation). 2004-12-30. . Retrieved 2009-04-21.

[10] The bone age flute (http://news.bbc.co.uk/1/low/sci/tech/454594.stm). BBC. Retrieved July 2007.

[11] Zhang, Juzhong; Xiao, Xinghua, Lee, Yun Kuen (December 2004). "The early development of music. Analysis of the Jiahu bone flutes" (http://antiquity.ac.uk/ant/078/Ant0780769.htm). *Antiquity* **78** (302): 769–778. .

[12] Howard L. Goodman (2010). *Xun Xu and the politics of precision in third-century AD China*. Brill Publishers. p. 226. ISBN 900418337X.

[13] Hoiberg, Dale; Ramchandani, Indu (2000). *Students' Britannica India* (http://books.google.com/?id=AE_LIg9G5CgC). Mumbai: Popular Prakashan. p. 125. ISBN 0852297602. .

[14] Chaturvedi, Mamta (2001). *How to Play Flute & Shehnai* (http://books.google.com/?id=0rz8rvUOmSwC). New Delhi: Diamond Pocket Books (P) Ltd. p. 7. ISBN 8128814761. .

[15] Morse, Constance (1968). *Music and Music-makers* (http://books.google.com/?id=XEXWVhtcuJ4C). New Hampshire: Ayer Publishing. p. 7. ISBN 0836907248. .

[16] Arvey, Verna (2007). *Choreographic Music for the Dance* (http://books.google.com/?id=GOwFSQkpfNsC). London: Read Country Books. p. 36. ISBN 1406758477. .

[17] Flute acoustics (http://www.phys.unsw.edu.au/jw/fluteacoustics.html#airjet), UNSW. Retrieved June 2007.

[18] Wolfe, Joe. "Introduction to flute acoustics" (http://www.phys.unsw.edu.au/music/flute/). *UNSW Music Acoustics*. . Retrieved 16 January 2006.

[19] Spell, Eldred (1983). "Anatomy of a Headjoint" (http://eldredspellflutes.com/Articles.htm). *The Flute Worker*. ISSN 0737-8459. .

[20] Wolfe, Joe. "Acoustic impedance of the flute" (http://www.phys.unsw.edu.au/~jw/fluteacoustics.html#acousticimpedance). *Flute acoustics: an introduction*. .

[21] Widholm, G.; Linortner, R., Kausel, W. and Bertsch, M. (2001). "Silver, gold, platinum—and the sound of the flute" (http://iwk.mdw.ac.at/Forschung/english/linortner/linortner_e.htm). *Proc. International Symposium on Musical Acoustics*: 277–280. .

[22] Boehm 1964, 8–12.

[23] Arnold, Alison (2000). *The Garland Encyclopedia of World Music* (http://books.google.com/?id=ZOlNv8MAXIEC). London: Taylor & Francis. p. 354. ISBN 0824049462. .

[24] Caudhurī, Vimalakānta Rôya; Roychaudhuri, Bimalakanta (2000). *The Dictionary of Hindustani Classical Music* (http://books.google.com/?id=gQWLa--IHjIC). Kolkata: Motilal Banarsidass Publication. ISBN 8120817087. .

[25] Abram, David; Guides, Rough; Edwards, Nick; Ford, Mike; Sen, Devdan; Wooldridge, Beth (2004). *The Rough Guide to South India 3* (http://books.google.com/?id=sEhJBfbhTAAC). London: Rough Guides. pp. 670, 671. ISBN 1843531038. .

[26] Pahlevanian 2001

[27] Komitas 1994

Bibliography

- Boehm, Theobald. 1964. *The Flute and Flute-Playing in Acoustical, Technical, and Artistic Aspects*, translated by Dayton C. Miller, with a new introduction by Samuel Baron. New York: Dover Publications. ISBN 0-486-21259-9
- Buchanan, Donna A. 2001. “Bulgaria §II: Traditional Music, 2: Characteristics of Pre-Socialist Musical Culture, 1800–1944, (iii): Instruments”. *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell. London: Macmillan.
- Crane, Frederick. 1972. *Extant Medieval Musical Instruments: A Provisional Catalogue by Types*. Iowa City: University of Iowa Press. ISBN 0-87745-022-6
- Galway, James. 1982. *Flute*. Yehudi Menuhin Music Guides. London: Macdonald. ISBN 0356047113 (cloth); ISBN 0356047121 (pbk.) New York: Schirmer Books. ISBN 002871380X Reprinted 1990, London: Kahn & Averill London: Khan & Averill ISBN 1871082137
- Komitas, Vardapet. 1994. *Grakan nshkhark' Komitas Vardapeti beghun grch'ēn: npast mē Komitas Vardapeti srbadasman harts'in*, edited by Abel Oghlukian. Montreal: Ganatahayots' Aṛajnordarani "K'ristonēakan Usman ew Astuatsabanut'ean Kedron".
- Pahlevanian, Alina. 2001. “Armenia §I: Folk Music, 3: Epics”. *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell. London: Macmillan.
- Phelan, James, *The Complete Guide to the [Flute and Piccolo]* (Burkart-Phelan, Inc., 2004)
- Putnik, Edwin. 1970. *The Art of Flute Playing*. Evanston, Illinois: Summy-Birchard Inc. Revised edition 1973, Princeton, New Jersey and Evanston, Illinois. ISBN 0874870771
- Toff, Nancy. 1985. *The Flute Book: A Complete Guide for Students and Performers*. New York: Charles's Scribners Sons. ISBN 0684182416 Newton Abbot: David & Charles. ISBN 0715387715 Second Edition 1996, New York: Oxford University Press. ISBN 0195105028
- Wye, Trevor. 1988. *Proper Flute Playing: A Companion to the Practice Books*. London: Novello. ISBN 0711984654
- Maclagan,Susan J. "A Dictionary for the Modern Flutist", 2009, Lanham, Maryland, USA: Scarecrow Press. ISBN 978-0-8108-6711-6

External links

- Creative Flute (http://creativeflute.org/). You can find more than 1000 public domain free sheet music scores.
- Essay on the Jiahu flutes (http://www.metmuseum.org/toah/hd/jiah/hd_jiah.htm) from the Heilbrunn Timeline of Art History at The Metropolitan Museum of Art

A selection of historic flutes from around the world at The Metropolitan Museum of Art

- Walking Stick Flute and Oboe, Georg Henrich Scherer, Butzbach, ca. 1750–57 (http://www.metmuseum.org/toah/hd/musd/ho_2006.86a-c.htm)
- Glass flute, Claude Laurent, Paris, 1813 (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/transverse_flute_in_d_flat_claude_laurent/objectview.aspx?page=1&sort=0&sortdir=asc&keyword=flute*&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180013281&vT=1)
- Porcelain flute, Saxony, 1760–1790 (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/transverse_flute_in_d_flat/objectview.aspx?page=2&sort=0&sortdir=asc&keyword=flute*&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180015833&vT=1)
- Pair of ivory flutes by Johann Wilhelm Oberlender, mid 18th century, Nuremberg (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/pair_of_transverse_flutes_johann_wilhelm_oberlender/objectview.aspx?page=5&sort=0&sortdir=asc&keyword=flute*&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180015236&vT=1)

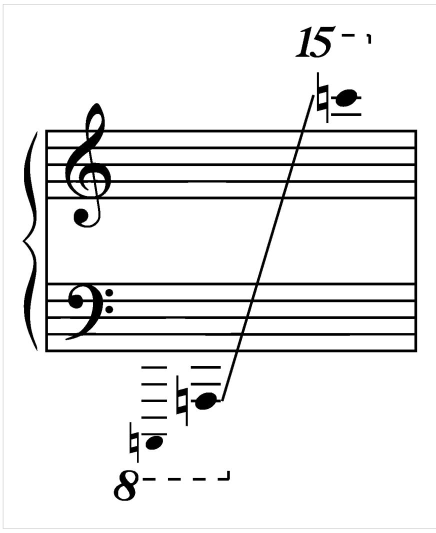
  - Flute by Garion, Paris, ca. 1720–1740 (http://www.metmuseum.org/works_of_art/collection_database/musical_instruments/transverse_flute_garion/objectview.aspx?page=6&sort=0&sortdir=asc&keyword=flute*&fp=1&dd1=18&dd2=0&vw=1&collID=18&OID=180016074&vT=1)
- nature.com New flutes document the earliest musical tradition in southwestern Germany (http://www.nature.com/nature/journal/vaop/ncurrent/full/nature08169.html)
- Flute (http://www.dmoz.org//Arts/Music/Instruments/Winds/Woodwinds/Flute/) at the Open Directory Project
- Flute acoustics (http://www.phys.unsw.edu.au/music/flute/) Resources on flute acoustics from the University of New South Wales.

Piano

Piano

Steinway grand piano

Keyboard instrument	
Hornbostel-Sachs classification	314.122-4-8 (Simple chordophone with keyboard sounded by hammers)
Inventor(s)	Bartolomeo Cristofori
Developed	Early 18th century
Playing range	



The **piano** is a musical instrument played by means of a keyboard. It is one of the most popular instruments in the world. Widely used in classical music for solo performances, ensemble use, chamber music and accompaniment, the piano is also very popular as an aid to composing and rehearsal. Although not portable and often expensive, the piano's versatility and ubiquity have made it one of the world's most familiar musical instruments.

Pressing a key on the piano's keyboard causes a felt-covered hammer to strike steel strings. The hammers rebound, allowing the strings to continue vibrating at their resonant frequency.[1] These vibrations are transmitted through a bridge to a sounding board that more efficiently couples the acoustic energy to the air. The sound would otherwise be no louder than that directly produced by the strings. When the key is released, a damper stops the string's vibration. See the article on Piano key frequencies for a picture of the piano keyboard and the location of middle-C. In the Hornbostel-Sachs system of instrument classification, pianos are considered chordophones.

The word *piano* is a shortened form of ***pianoforte***, the Italian word for the instrument (which in turn derives from the previous terms "gravicembalo col piano e forte" and fortepiano). The musical terms "piano" and "forte" mean "quiet" and "loud," and in this context refers to the variations in volume of sound the instrument produces in response to a pianist's touch on the keys: the greater a key press's velocity, the greater the force of the hammer hitting the string(s), and the louder the note produced.

History

Early history

The piano is founded on earlier technological innovations. The first string instruments with struck strings were the hammered dulcimers.[2] During the Middle Ages, there were several attempts at creating stringed keyboard instruments with struck strings.[3] By the 17th century, the mechanisms of keyboard instruments such as the clavichord and the harpsichord were well known. In a clavichord the strings are struck by tangents, while in a harpsichord they are plucked by quills. Centuries of work on the mechanism of the harpsichord in particular had shown the most effective ways to construct the case, soundboard, bridge, and keyboard.

Grand piano by Louis Bas of Villeneuve-lès-Avignon, France, 1781. Earliest French grand piano known to survive; includes an inverted wrestplank and action derived from the work of Bartolomeo Cristofori (ca. 1700) with ornately decorated soundboard.

The invention of the modern piano is credited to Bartolomeo Cristofori (1655–1731) of Padua, Italy, who was employed by Ferdinando de' Medici, Grand Prince of Tuscany, as the Keeper of the Instruments. He was an expert harpsichord maker, and was well acquainted with the body of knowledge on stringed keyboard instruments. It is not known exactly when Cristofori first built a piano. An inventory made by his employers, the Medici family, indicates the existence of a piano by the year 1700; another document of doubtful authenticity indicates a date of 1698. A friend of the family by the name of Sebastian LeBlanc suggested the idea to switch the black and white keys The three Cristofori pianos that survive today date from the 1720s.[4] [5]

Early piano replica by the modern builder Paul McNulty, after Walter & Sohn, 1805

While the clavichord allowed expressive control of volume and sustain, it was too quiet for large performances. The harpsichord produced a sufficiently loud sound, but had little expressive control over each note. The piano was likely formed as an attempt to combine loudness with control, avoiding the trade-offs of available instruments.

Cristofori's great success was solving, with no prior example, the fundamental mechanical problem of piano design: the hammer must strike the string, but not remain in contact with it (as a tangent remains in contact with a clavichord string) because this would dampen the sound. Moreover, the hammer must return to its rest position without bouncing violently, and it must be possible to repeat a note rapidly. Cristofori's piano action was a model for the many different approaches to piano actions that followed. Cristofori's early instruments were made with thin strings, and were much quieter than the modern piano—but compared to the

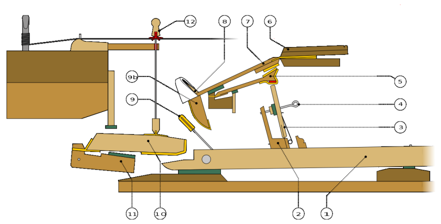
clavichord (the only previous keyboard instrument capable of dynamic nuance via the keyboard) they were much louder and had more sustain.

Cristofori's new instrument remained relatively unknown until an Italian writer, Scipione Maffei, wrote an enthusiastic article about it (1711), including a diagram of the mechanism. This article was widely distributed, and most of the next generation of piano builders started their work due to reading it. One of these builders was Gottfried Silbermann, better known as an organ builder. Silbermann's pianos were virtually direct copies of Cristofori's, with one important addition: Silbermann invented the forerunner of the modern damper pedal, which lifts all the dampers from the strings simultaneously.

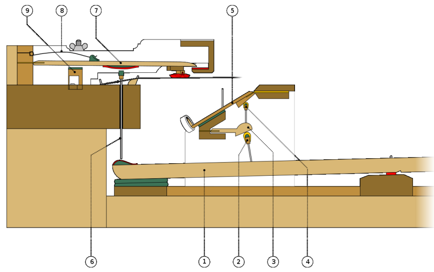
Silbermann showed Johann Sebastian Bach one of his early instruments in the 1730s, but Bach did not like it at that time, claiming that the higher notes were too soft to allow a full dynamic range. Although this earned him some animosity from Silbermann, the criticism was apparently heeded. Bach did approve of a later instrument he saw in 1747, and even served as an agent in selling Silbermann's pianos.[6]

Piano-making flourished during the late 18th century in the Viennese school, which included Johann Andreas Stein (who worked in Augsburg, Germany) and the Viennese makers Nannette Streicher (daughter of Stein) and Anton Walter. Viennese-style pianos were built with wood frames, two strings per note, and had leather-covered hammers. Some of these Viennese pianos had the opposite coloring of modern-day pianos; the natural keys were black and the accidental keys white.[7] It was for such instruments that Wolfgang Amadeus Mozart composed his concertos and sonatas, and replicas of them are built today for use in authentic-instrument performance of his music. The pianos of Mozart's day had a softer, more ethereal tone than today's pianos or English pianos, with less sustaining power. The term *fortepiano* is nowadays often used to distinguish the 18th-century instrument from later pianos.

In the period lasting from about 1790 to 1860, the Mozart-era piano underwent tremendous changes that led to the modern form of the instrument. This revolution was in response to a preference by composers and pianists for a more powerful, sustained piano sound, and made possible by the ongoing Industrial Revolution with resources such as high-quality piano wire for strings, and precision casting for the production of iron frames. Over time, the tonal range of the piano was also increased from the five octaves of Mozart's day to the 7¼ or more octaves found on modern pianos.


Broadwood square action

Early technological progress owed much to the firm of Broadwood. John Broadwood joined with another Scot, Robert Stodart, and a Dutchman, Americus Backers, to design a piano in the harpsichord case—the origin of the "grand". They achieved this in about 1777. They quickly gained a reputation for the splendour and powerful tone of their instruments, with Broadwood constructing ones that were progressively larger, louder, and more robustly constructed. They sent pianos to both Joseph Haydn and Ludwig van Beethoven, and were the first firm to build pianos with a range of more than five octaves: five octaves and a fifth during the 1790s, six octaves by 1810 (Beethoven used the extra notes in his later works), and seven octaves by 1820. The Viennese makers similarly followed these trends, however the two schools used different piano actions: Broadwoods were more robust, Viennese instruments were more sensitive.


Erard square action

By the 1820s, the center of innovation had shifted to Paris, where the Pleyel firm manufactured pianos used by Frédéric Chopin and the Érard firm manufactured those used by Franz Liszt. In 1821, Sébastien Érard invented the double escapement action, which incorporated a *repetition lever* (also called the *balancier*) that permitted a note to be repeated even if the key had not yet risen to its maximum vertical position. This facilitated rapid playing of repeated notes, and this musical device was pioneered by Liszt. When the invention became public, as revised by Henri Herz, the double escapement action gradually became standard in grand pianos, and is still incorporated into all grand pianos currently produced.

Other improvements of the mechanism included the use of felt hammer coverings instead of layered leather or cotton. Felt, which was first introduced by Henri Pape in 1826, was a more consistent material, permitting wider dynamic ranges as hammer weights and string tension increased. The sostenuto pedal (see below), invented in 1844 by Jean Louis Boisselot and improved by the Steinway firm in 1874, allowed a wider range of effects.

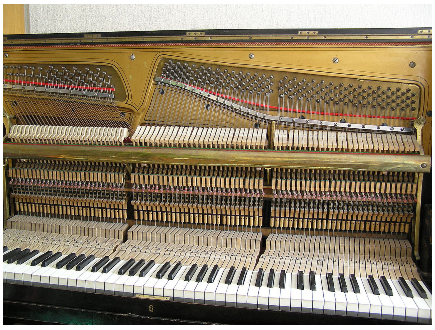
One of the major technical innovations that helped to create the sound of the modern piano was the use of a strong iron frame. Also called the "plate", the iron frame sits atop the soundboard, and serves as the primary bulwark against the force of string tension. The increased structural integrity of the iron frame allowed the use of thicker, tenser, and more numerous strings. In a modern grand the total string tension can exceed 20 tons. The single piece cast iron frame was patented in 1825 in Boston by Alpheus Babcock, combining the metal hitch pin plate (1821, claimed by Broadwood on behalf of Samuel Hervé) and resisting bars (Thom and Allen, 1820, but also claimed by Broadwood and Érard). Babcock later worked for the Chickering & Mackays firm who patented the first full iron frame for grand pianos in 1843. Composite forged metal frames were preferred by many European makers until the American system was fully adopted by the early 20th century.

Other important advances included changes to the way the piano was strung, such as the use of a "choir" of three strings rather than two for all but the lowest notes, and the implementation of an over-strung scale in which the strings are placed in two separate planes, each with its own bridge height. (This is also called "cross-stringing". Whereas earlier instruments' bass strings were a mere continuation of a single string plane, over-stringing placed the bass bridge behind and to the treble side of the tenor bridge area. This *crossed* the strings, with the bass strings in the higher plane.) This permitted a much narrower cabinet at the "nose" end of the piano, and optimized the transition from unwound tenor strings to the iron or copper-wrapped bass strings. Over-stringing was invented by Jean-Henri Pape during the 1820s, and first patented for use in grand pianos in the United States by Henry Steinway, Jr. in 1859.

Duplex scaling, patented in 1872 by Theodore Steinway, enhanced the voice of each note by using sympathetic vibration. Short lengths of non-speaking wire were bridged by the aliquot throughout much of upper range of the piano, always in locations that caused them to vibrate in conformity with their respective overtones—typically in doubled octaves and twelfths. Somewhat similar systems were developed by Blüthner (Aliquot stringing, 1873), as well as Taskin [8] (1788), and Collard (1821). Each used more distinctly ringing, undamped vibrations to modify tone.

Duplex scaling of an 1883 Steinway Model 'A'. From lower left to upper right: main sounding length of strings, treble bridge, duplex string length, duplex bar (nickel-plated bar parallel to bridge), hitchpins, plate strut with bearing bolt, plate hole.

Some early pianos had shapes and designs that are no longer in use. The square piano (not truly square, but rectangular) was cross strung at an extremely acute angle above the hammers, with the keyboard set along the long side. This design is attributed to Gottfried Silbermann or Christian Ernst Friderici on the continent, and Johannes Zumpe or Harman Vietor in England, and it was improved by changes first introduced by Guillaume-Lebrecht Petzold in France and Alpheus Babcock in the United States. Square pianos were built in great numbers through the 1840s in Europe and the 1890s in America, and saw the most visible change of any type of piano: the iron-framed, over-strung squares manufactured by Steinway & Sons were more than two-and-a-half times the size of Zumpe's wood-framed instruments from a century before. Their overwhelming popularity was due to inexpensive construction and price, although their tone and performance were limited by narrow soundboards, simple actions and string spacing that made proper hammer alignment difficult.



The mechanism in upright pianos is perpendicular to the keys.

The tall, vertically strung upright grand was arranged like a grand set on end, with the soundboard and bridges above the keys, and tuning pins below them. The term was later revived by many manufacturers for advertising purposes. Giraffe, pyramid and lyre pianos were arranged in a somewhat similar fashion in evocatively shaped cases.

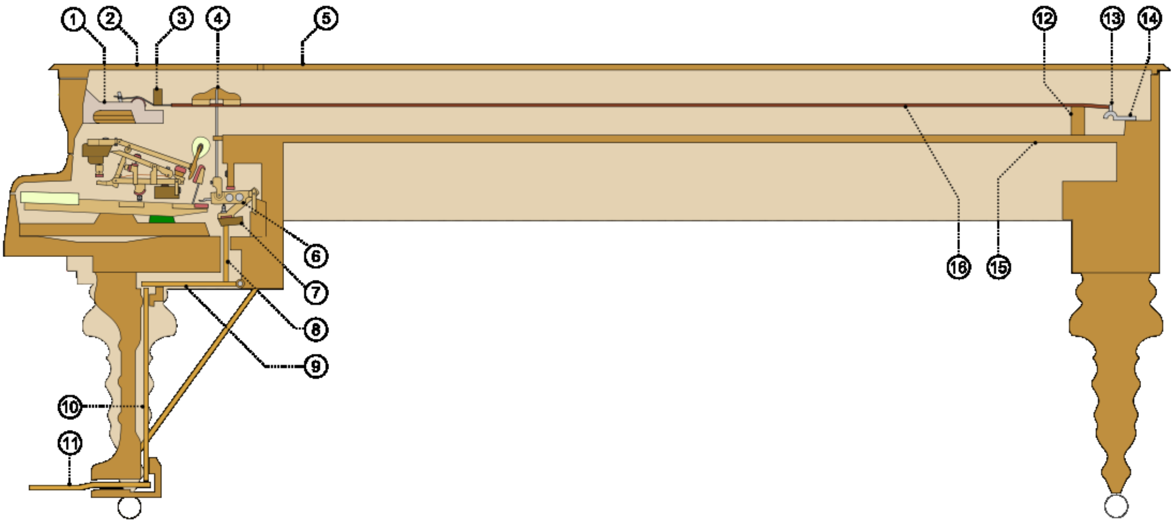
The very tall cabinet piano was introduced about 1805 and was built through the 1840s. It had strings arranged vertically on a continuous frame with bridges extended nearly to the floor, behind the keyboard and very large *sticker action*. The short cottage upright or *pianino* with vertical stringing, made popular by Robert Wornum around 1815, was built into the 20th century. They are informally called *birdcage pianos* because of their prominent damper mechanism. Pianinos were distinguished from the oblique, or diagonally strung upright made popular in France by Roller & Blanchet during the late 1820s. The tiny spinet upright was manufactured from the mid-1930s until recent times. The low position of the hammers required the use of a "drop action" to preserve a reasonable keyboard height.

Modern upright and grand pianos attained their present forms by the end of the 19th century. Improvements have been made in manufacturing processes, and many individual details of the instrument continue to receive attention.

History and musical performance

Much of the most widely admired piano repertoire, for example, that of Haydn, Mozart, and Beethoven, was composed for a type of instrument (the pianoforte) that is rather different from the modern instruments on which this music is normally performed today. Even the music of the Romantics, including Liszt, Chopin, Robert Schumann, Felix Mendelssohn and Johannes Brahms, was written for pianos substantially different from modern pianos.

Modern piano



A schematic depiction of the construction of a pianoforte (part names are listed in the illustration's file)

Types

Modern pianos have two basic configurations (with subcategories): the grand piano and the upright piano.

Grand

In grand pianos, the frame and strings are horizontal, with the strings extending away from the keyboard. The action lies beneath the strings, and uses gravity as its means of return to a state of rest.


Steinway grand piano in the White House

There are many sizes of grand piano. A rough generalization distinguishes the *concert grand* (between about 2.2 m and 3 m/9.84 feet long) from the *parlor grand* or *boudoir grand* (about 1.7 m to 2.2 m) and the smaller *baby grand* (around 1.5 m).

All else being equal, longer pianos with longer strings have larger, richer sound and lower inharmonicity of the strings. Inharmonicity is the degree to which the frequencies of overtones (known as partials or harmonics) sound sharp relative to whole multiples of the fundamental frequency. This results from the piano's considerable string stiffness; as a struck string decays its harmonics vibrate, not from their termination, but from a point very slightly toward the center (or more flexible part) of the string. The higher the partial, the further sharp it runs. Pianos with shorter and thicker strings, i.e. small pianos with short string

August Förster upright piano

scales, have more inharmonicity. The greater the inharmonicity, the more the ear perceives it as harshness of tone.

Inharmonicity requires octaves to be "stretched", or tuned to a lower octave's corresponding sharp overtone rather than to a theoretically correct octave. If octaves are not stretched, single octaves sound in tune, but double—and notably triple—octaves are unacceptably narrow. Stretching a small piano's octaves to match its inherent inharmonicity level creates an imbalance among all the instrument's intervallic relationships, not just its octaves. In a concert grand, however, the octave "stretch" retains harmonic balance, even when aligning treble notes to a harmonic produced from three octaves below. This lets close and widespread octaves sound pure, and produces virtually beatless perfect fifths. This gives the concert grand a brilliant, singing and sustaining tone quality—one of the principal reasons that full-size grands are used in the concert hall. Smaller grands satisfy the space and cost needs of domestic use.

Upright/vertical

Upright pianos, also called vertical pianos, are more compact because the frame and strings are vertical. The hammers move horizontally, and return to their resting position via springs, which are susceptible to degradation. Upright pianos with unusually tall frames and long strings are sometimes called *upright grand* pianos. Some authors classify modern pianos according to their height and to modifications of the action that are necessary to accommodate the height.

- *Studio* pianos are around 42 to 45 inches tall. This is the shortest cabinet that can accommodate a full-sized action located above the keyboard.
- *Console* pianos have a compact action (shorter hammers), and are a few inches shorter than studio models.
- The top of a *spinet* model barely rises above the keyboard. The action is located below, operated by vertical wires that are attached to the backs of the keys.
- Anything taller than a studio piano is called an *upright*.

Other types

Steinway player piano from 1920.

The 19th century saw the introduction of the toy piano.

In 1863, Henri Fourneaux invented the player piano, which plays itself from a piano roll. A machine perforates a performance recording into rolls of paper, and the player piano replays the performance using pneumatic devices. Modern equivalents of the player piano include the Bösendorfer CEUS and the Yamaha disklavier, using solenoids and MIDI rather than pneumatics and rolls.

A silent piano is an acoustic piano having an option to silence the strings by means of an interposing hammer bar. They are designed for private silent practice.

Edward Ryley invented the transposing piano in 1801. It has a lever under the keyboard as to move the keyboard relative to the strings so a pianist can play in a familiar key while the music sounds in a different key.

The prepared piano, present in some contemporary art music, is a piano with objects placed inside it to alter its sound, or has had its mechanism changed in some other way. The scores for music for prepared piano specify the modifications, for example instructing the pianist to insert pieces of rubber, paper, metal screws, or washers in between the strings. These either mute the strings or alter their timbre. A harpsichord-like sound can be produced by

placing or dangling small metal buttons in front of the hammer.

Electric pianos use electromagnetic pickups to amplify the sound of the strings. Playing a note loudly causes the electric signal to clip, and the player can incorporate the distortion into his or her expressive range.

Digital pianos use digital sampling technology to reproduce the sound of each piano note. Digital pianos can be sophisticated, with features including working pedals, weighted keys, multiple voices, and MIDI interfaces. However, when one depresses the damper pedal (see below) on such an instrument, there are no strings to vibrate sympathetically. The synthesis software of some higher end digital pianos, such as the Yamaha Clavinova series, or the KAWAI MP8 series, incorporates physical models of sympathetic vibration.

With the advent of powerful desktop computers, highly realistic pianos have become available as affordable software modules. Some of these modules, such as the 2004 Synthogy's Ivory, use multi-gigabyte piano sample sets with as many as 90 recordings, each lasting many seconds, for each of the 88 (some have 81) keys under different conditions. Additional samples emulate sympathetic resonance, key release, the drop of the dampers, and simulations of piano techniques like re-pedaling to augment these conditions. Some other software modules, such as Modartt's 2006 Pianoteq, use no samples whatsoever and are a pure synthesis of all aspects of the physicalities that go into the creation of a real piano's sound.

Today, piano manufactures take advantage of innovative pianos that play themselves via a CD or MP3 player. Similar in concept to a player piano, the PianoDisc or iQ systems allow pianos to "play themselves" when the software interprets a certain file format. Such additions are quite expensive, often doubling the cost of a piano. These pianos are available in both upright and grand.

Keyboard

Further information: Musical keyboard

Keyboard of a Steinway grand piano

Almost every modern piano has 36 black keys and 52 white keys for a total of 88 keys (seven octaves plus a minor third, from A_0 to C_8). Many older pianos only have 85 keys (seven octaves from A_0 to A_7), while some manufacturers extend the range further in one or both directions.

Some Bösendorfer pianos, for example, extend the normal range down to F_0, with one other model going as far as a bottom C_0, making a full eight octave range. These extra keys are sometimes hidden under a small hinged lid that can cover the keys to prevent visual disorientation for pianists unfamiliar with the extra keys. On others, the colors of the extra white keys are reversed (black instead of white).

The extra keys are added primarily for increased resonance from the associated strings; that is, they vibrate sympathetically with other strings whenever the damper pedal is depressed and thus give a fuller tone. Only a very small number of works composed for piano actually use these notes. More recently, the Stuart and Sons company has also manufactured extended-range pianos, with the first 102 key piano. On their instruments, the frequency range extends from C_0 to F_8, which is the widest practical range for the acoustic piano. The extra keys are the same as the other keys in appearance.

Small studio upright acoustical pianos with only 65 keys have been manufactured for use by roving pianists. Known as *gig* pianos and still containing a cast iron harp, these are comparatively lightweight and can be easily transported to and from engagements by only two people. As their harp is longer than that of a spinet or console piano, they have a stronger bass sound that to some pianists is well worth the trade-off in range that a reduced key-set offers.

The toy piano manufacturer Schoenhut started manufacturing both grands and uprights with only 44 or 49 keys, and shorter distance between the keyboard and the pedals. These pianos are true pianos with action and strings. The

pianos were introduced to their product line in response to numerous requests in favor of it.

Pianos have been built with alternative keyboard systems, e.g., the Jankó keyboard.

Pedals

Standard pedals

Piano pedals from left to right: una corda, sostenuto, and sustain pedal

Pianos have had pedals, or some close equivalent, since the earliest days. (In the 18th century, some pianos used levers pressed upward by the player's knee instead of pedals.) Most grand pianos in the US have three pedals: the soft pedal (una corda), sostenuto, and sustain pedal (from left to right, respectively), while in Europe, the standard is two pedals: the soft pedal and the sustain pedal. Most modern upright pianos also have three pedals: soft pedal, practice pedal and sustain pedal, though older or cheaper models may lack the practice pedal. In Europe the standard for upright pianos is two pedals: the soft and the sustain pedals.

The sustain pedal (or, damper pedal) is often simply called "the pedal", since it is the most frequently used. It is placed as the rightmost pedal in the group. It lifts the dampers from all keys, sustaining all played notes. In addition, it alters the overall tone by allowing all strings, including those not directly played, to reverberate.

The soft pedal or *una corda* pedal is placed leftmost in the row of pedals. In grand pianos it shifts the entire action/keyboard assembly to the right (a very few instruments have shifted left) so that the hammers hit two of the three strings for each note. In the earliest pianos whose unisons were bichords rather than trichords, the action shifted so that hammers hit a single string, hence the name *una corda*, or 'one string'. The effect is to soften the note as well as change the tone. In uprights this action is not possible; instead the pedal moves the hammers closer to the strings, allowing the hammers to strike with less kinetic energy. This produces a slightly softer sound, but no change in timbre.

On grand pianos, the middle pedal is a sostenuto pedal. This pedal keeps raised any damper already raised at the moment the pedal is depressed. This makes it possible to sustain selected notes (by depressing the sostenuto pedal before those notes are released) while the player's hands are free to play additional notes (which aren't sustained). This can be useful for musical passages with pedal points and other otherwise tricky or impossible situations.

On many upright pianos, the middle pedal is called the "practice" or *celeste* pedal. This drops a piece of felt between the hammers and strings, greatly muting the sounds. Often this pedal can be shifted while depressed, into a "locking" position.

There are also non-standard variants. On some pianos (grands and verticals), the middle pedal can be a bass sustain pedal: that is, when it is depressed, the dampers lift off the strings only in the bass section. Players use this pedal to sustain a single bass note or chord over many measures, while playing the melody in the treble section. On the Stuart and Sons piano as well as the largest Fazioli piano, there is a fourth pedal to the left of the principal three. This fourth pedal works in the same way as the soft pedal of an upright piano, moving the hammers closer to the strings.[9]

Unusual pedals


An upright pedal piano by Challen

The rare transposing piano (such as owned by Irving Berlin) has a middle pedal that functions as a clutch that disengages the keyboard from the mechanism, enabling the keyboard to be moved to the left or right with a lever. The entire action of the piano is thus shifted to allow the pianist to play music written in one key so that it sounds in a different key.

There were three piano companies to include extra pedals other than the standard two or three. Two of these companies offered a piano with four pedals (Crown and Schubert Piano Co.), and Wing and Son of New York offered a five-pedal piano from approximately 1893 through the 1920s. There is no mention of the company past the 1930s. Labeled left to right the pedals are Mandolin, Orchestra, Expression, Soft, and Forte (Sustain). The Mandolin pedal produces a sound similar to a vibrato feel by bouncing a set of small hammers against the strings, enabling the piano to mimic a mandolin, guitar, banjo, zither and harp. The Orchestra (Orch) pedal used a similar approach, lowering a set of metal-tipped felt strips in between the hammers and the strings. This extended the life of the hammers when the Orch pedal was used, a good idea for practicing, and created an echo-like sound that mimicked playing in an orchestral hall.[10] [11]

The *pedalier* piano, or pedal piano, is a rare type of piano that includes a pedalboard, enabling bass register notes to be played with the feet, as is standard on the organ. There are two types of pedal piano: the pedal board may be an integral part of the instrument, using the same strings and mechanism as the manual keyboard, or, less frequently, it may consist of two independent pianos (each with its separate mechanics and strings), which are placed one above the other, a regular piano played by the hands and a bass-register piano played by the feet. This was developed primarily as a practice instrument for organists, although there is a small repotoire written specifically for the instrument.

Construction

Many parts of a piano are made of materials selected for strength and longevity. This is especially true of the outer rim. It is most commonly made of hardwood, typically maple or beech, and its massiveness serves as an essentially immobile object from which the flexible soundboard can best vibrate. According to Harold A. Conklin,[12] the purpose of a sturdy rim is so that "the vibrational energy will stay as much as possible in the soundboard instead of dissipating uselessly in the case parts, which are inefficient radiators of sound."

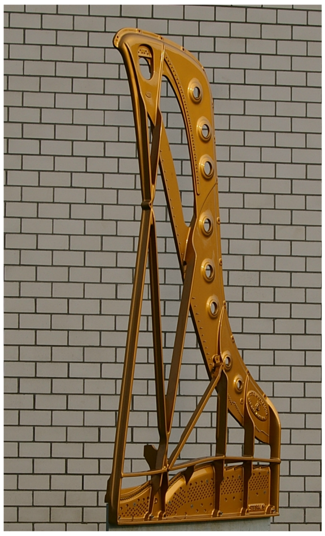
Yet Bösendorfer, the Austrian manufacturer of high quality pianos, constructs their rim from spruce, the very same wood that the soundboard is made from. Their idea is to concertedly involve the cabinet in the projection and coloration of sound. The *loss* of energy into the Bösendorfer case alters the instrument's tone, giving it perhaps less power but a complex and unusually resonant sound.

View from below of a 182-cm grand piano. In order of distance from viewer: softwood braces, tapered soundboard ribs, soundboard. The metal rod at lower right is a humidity control device.

The finest hardwood rims are made by laminating thin (hence flexible) strips of hardwood, bending them to the desired shape immediately after the application of glue. This system was developed by Theodore Steinway in 1880. The thick wooden posts on the underside (grands) or back (uprights) of the piano stabilize the rim structure, and are made of softwood for stability. The requirement of structural strength, fulfilled by stout hardwood and thick metal, makes a piano heavy; even a small upright can weigh 136 kg (300 lb), and the Steinway concert grand (Model D) weighs 480 kg (990 lb). The largest piano built, the Fazioli F308, weighs 691 kg (1520 lb).

The pinblock, which holds the tuning pins in place, is another area where toughness is important. It is made of hardwood, (typically hard maple or beech), and is laminated for strength, stability and longevity. Piano strings (also called piano wire), which must endure years of extreme tension and hard blows, are made of high carbon steel. They are manufactured to vary as little as possible in diameter, since all deviations from uniformity introduce tonal distortion. The bass strings of a piano are made of a steel core wrapped with copper wire, to increase their mass whilst retaining flexibility. If all strings throughout the piano's compass were individual (monochord), the massive bass strings would overpower the upper ranges. Makers compensate for this with the use of double (bichord) strings in the tenor and triple (trichord) strings throughout the treble.

The plate, or metal frame, of a piano is usually made of cast iron. It is advantageous for the plate to be very massive. Since the strings vibrate from the plate at both ends, vibrations absorbed by the plate result in energy loss to the desired (efficient) sound transmission channel, namely the bridge and the soundboard. While some manufacturers use cast steel in their plates, most prefer cast iron. Cast iron is easy to cast and machine, has flexibility sufficient for piano use, is much more resistant to deformation than steel, and is especially tolerant of compression. Plate casting is an art, since dimensions are crucial and the iron shrinks about one percent during cooling.



Cast iron plate of a Steinway grand piano

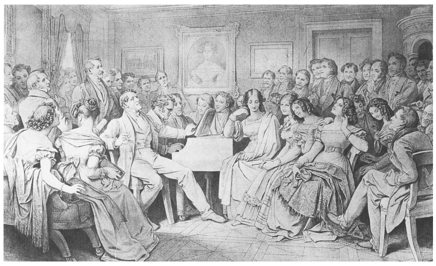
Including an extremely large piece of metal in a piano is potentially an aesthetic handicap. Piano makers overcome this by polishing, painting, and decorating the plate. Plates often include the manufacturer's ornamental medallion. In an effort to make pianos lighter, Alcoa worked with Winter and Company piano manufacturers to make pianos using an aluminum plate during the 1940s. Aluminum piano plates were not widely accepted, and were discontinued.

The numerous grand parts and upright parts of a piano action are generally hardwood, e.g., maple, beech, or hornbeam. However, since WWII, makers have used some plastics. Early plastics were incorporated into some pianos in the late 1940s and 1950s, but proved disastrous because they lost strength after a few decades of use. The Steinway firm once incorporated Teflon, a synthetic material developed by DuPont, for some grand action parts in place of cloth, but abandoned the experiment due to excessive friction and a "clicking" that developed over time. (Teflon is "humidity stable" whereas the wood adjacent to the Teflon swells and shrinks with humidity changes, causing problems.) More recently, the Kawai firm built pianos with action parts made of more modern materials such as carbon fiber reinforced plastic, and the piano parts manufacturer Wessell, Nickel and Gross has launched a new line of carefully engineered composite parts. Thus far these parts have performed reasonably, but it will take decades to know if they equal the longevity of wood.

In all but the poorest pianos the soundboard is made of solid spruce (that is, spruce boards glued together along the side grain). Spruce's high ratio of strength to weight minimizes acoustic impedance while offering strength sufficient to withstand the downward force of the strings. The best piano makers use quarter-sawn, defect-free spruce of close annular grain, carefully seasoning it over a long period before fabricating the soundboards. Cheap pianos often have plywood soundboards.

In the early years of piano construction, keys were commonly made from sugar pine. Today they are likely to be made of spruce or basswood. Spruce is typically used in high-quality pianos. The black keys were traditionally made from ebony and the white keys were covered with strips of ivory, but since ivory-yielding species are now endangered and protected by treaty, plastics are now almost exclusively used. Also, ivory tends to chip more easily than plastic. Legal ivory can still be obtained in limited quantities. The Yamaha firm invented a plastic called "Ivorite" that they claim mimics the look and feel of ivory; it has since been imitated by other makers.

Care and maintenance


The piano at the social center in the 19th century (Moritz von Schwind, 1868). The man at the piano is Franz Schubert.

Pianos need regular tuning to keep them on pitch, which is usually the internationally recognized standard concert pitch of A4 = 440 Hz. The hammers of pianos are voiced to compensate for gradual hardening, and other parts also need periodic regulation. Aged and worn pianos can be rebuilt or reconditioned. Often, by replacing a great number of their parts, they can perform as well as new pianos. Older pianos are often more settled and produce a warmer tone.

Piano moving should be done by trained piano movers using adequate manpower and the correct equipment for any particular piano's size and weight. Pianos are heavy yet delicate instruments. Over the years, professional piano movers have developed special techniques for transporting both grands and uprights, which prevent damage to the case and to the piano's mechanics.

Tuning


A piano tuner

The relationship between two pitches, called an interval, is the ratio of their absolute frequencies. Two different intervals are perceived as the same when the pairs of pitches involved share the same frequency ratio. The easiest intervals to identify, and the easiest intervals to tune, are those that are just, meaning they have a simple whole-number ratio. The term *temperament* refers to a tuning system that tempers the just intervals (usually the perfect fifth, which has the ratio 3:2) to satisfy another mathematical property; in equal temperament, a fifth is tempered by narrowing it slightly, achieved by flattening its upper pitch slightly, or raising its lower pitch slightly. A temperament system is also known as a set of **bearings**.

Tempering an interval causes it to beat, which is a fluctuation in perceived sound intensity due to interference between close (but unequal) pitches. The rate of beating is equal to the frequency differences of any harmonics that are present for both pitches and that coincide or nearly coincide.

Piano tuning is the act of adjusting the tensions of the piano's strings, thereby aligning the intervals among their tones so that the instrument is in tune. The meaning of the term *in tune* in the context of piano tuning is not simply a particular fixed set of pitches. Fine piano tuning carefully assesses the interaction among all notes of the chromatic scale, different for every piano, and thus requires slightly different pitches from any theoretical standard. Pianos are

usually tuned to a modified version of the system called equal temperament (*see Piano key frequencies for the theoretical piano tuning*). In all systems of tuning, each pitch is derived from its relationship to a chosen fixed pitch, usually A440.[13]

Physics

When the key is struck, a chain reaction occurs to produce the sound. First, the key raises the wippen, which forces the jack against the hammer roller (or "knuckle"). The hammer roller then lifts the lever carrying the hammer. The key also raises the damper; and immediately after the hammer strikes the wire it falls back, allowing the wire to resonate. When the key is released the damper falls back onto the strings, stopping the wire from vibrating.[14] The vibrating piano strings themselves are not very loud, but their vibrations are transmitted to a large soundboard that moves air and thus converts the energy to sound. The irregular shape and off-center placement of the bridge ensures that the soundboard vibrates strongly at all frequencies.[15] (See Piano action for a diagram and detailed description of piano parts.)

There are three factors that influence the pitch of a vibrating wire.

- Length: All other factors the same, the shorter the wire, the higher the pitch.
- Mass per unit length: All other factors the same, the thinner the wire, the higher the pitch.
- Tension: All other factors the same, the tighter the wire, the higher the pitch.

A vibrating wire subdivides itself into many parts vibrating at the same time. Each part produces a pitch of its own, called a partial. A vibrating string has one fundamental and a series of partials. The most pure combination of two pitches is when one is double the frequency of the other.[16]

For a repeating wave, the velocity, v, equals the wavelength, λ, times the frequency, f.

$$v = \lambda f$$

On the piano string, waves reflect from both ends. The superposition of reflecting waves results in a standing wave pattern, but only for wavelengths $\lambda = 2L, L, L/2, \ldots = 2L/n$, where L is the length of the string. Therefore the only frequencies produced on a single string are $f = nv/(2L)$. Timbre is largely determined by the content of these harmonics. Different instruments have different harmonic content for the same pitch. A real string vibrates at harmonics that are not perfect multiples of the fundamental. This results in a little inharmonicity, which gives richness to the tone but causes significant tuning challenges throughout the compass of the instrument.[15]

Striking the piano key with greater force increases the amplitude of the waves and therefore the volume. From *pianissimo* (*pp*) to *fortissimo* (*ff*) the hammer velocity changes by almost a factor of a hundred. The hammer contact time with the string shortens from 4 ms at *pp* to less than 2 ms at *ff*.[15] If two wires adjusted to the same pitch are struck at the same time, the sound produced by one reinforces the other, and a louder combined sound of shorter duration is produced. If one wire vibrates out of synchronization with the other, they subtract from each other and produce a softer tone of longer duration.[17]

Well-known piano makers

Some well-known piano makers are (in alphabetical order): Baldwin, Bechstein, Behr Brothers Piano Company, Blüthner, Bösendorfer, Broadwood, Fazioli, Feurich, Förster, Heintzman, Kawai, Mason & Hamlin, Overs, Pearl River, Petrof, Pleyel, Schimmel, Steingraeber & Söhne, Steinway & Sons, Stuart & Sons, Wm. Knabe & Co., Yamaha.

Role

The piano is a crucial instrument in Western classical music, jazz, film, television, and most other complex western musical genres. A large number of composers are proficient pianists—and because the piano keyboard offers an easy means of complex melodic and harmonic interplay—the piano is often used as a tool for composition.

Pianos were, and still are, popular instruments for private household ownership.

Pianos sometimes referred to by nicknames including: "the ivories", "the joanna", "the eighty-eight", "the black(s) and white(s)", and "the little joe(s)". Playing the piano is sometimes referred to as "tickling the ivories".

Notes

[1] John Kiehl. "Hammer Time" (http://demonstrations.wolfram.com/HammerTime). Wolfram Demonstrations Project. .

[2] David R. Peterson (1994), "Acoustics of the hammered dulcimer, its history, and recent developments", *Journal of the Acoustical Society of America* **95** (5), p. 3002.

[3] Pollens, Stewart (October 1995). *The Early Pianoforte*. Cambridge University Press. ISBN 0521417295. Chapter 1.

[4] Erlich, Cyril (May 1990). *The Piano: A History*. Oxford University Press, USA; Revised edition. ISBN 0198161719.

[5] http://www.metmuseum.org/toah/hd/cris/hd_cris.htm

[6] Palmieri, Bob & Meg (May 2003). *The Piano: An Encyclopedia*. Taylor & Francis. ISBN 9780415937962.. "Instrument: piano et forte genandt" [was] an expression Bach also used when acting as Silbermann's agent in 1749."

[7] "The Viennese Piano" (http://www.ptg.org/resources-historyOfPianos-viennese.php). . Retrieved 2007-10-09.

[8] http://mediatheque.cite-musique.fr/ClientBookLineCIMU/recherche/NoticeDetailleByID.asp?ID=0162147

[9] "Fourth pedal" (http://web.archive.org/web/20080416203256/http://www.fazioli.com/eng/quarto_pedale.php). Fazioli. Archived from the original (http://www.fazioli.com/eng/quarto_pedale.php) on 2008-04-16. . Retrieved 2008-04-21.

[10] "Piano with instrumental attachments" (http://musicaviva.com/encyclopedia/display.html?phrase=piano-with-instrumental-attachments). Musica Viva. . Retrieved 27 August 2010.

[11] "Wing & Son" (http://www.antiquepianoshop.com/online-museum/wing-son/). Antique Piano Shop. . Retrieved 27 August 2010.

[12] "The piano case" (http://www.speech.kth.se/music/5_lectures/conklin/thepianocase.html). *Five lectures on the Acoustics of the piano*. Royal Swedish Academy of Music. 1990. . Retrieved 30 August 2010.

[13] Piano tuning

[14] Macaulay, David. The New How Things Work. From Levers to Lasers, Windmills to Web Sites, A Visual guide to the World of Machines. Houghton Mifflin Company. United States. 1998. ISBN 0-395-93847-3. pp. 26-27.

[15] Physics of the Piano by the Piano Tuners Guild (http://www.physics.odu.edu/~hyde/Teaching/Phys332_Wk13.ppt)

[16] Reblitz, Arthur A. Piano Servicing, Tuning, and Rebuilding. For the Professional, the student, and the Hobbyist. Vestal Press, Lanham Maryland. 1993. ISBN 1-879511-03-7 Pp. 203-215. Piano Servicing, Tuning, and Rebuilding. For the Professional, the student, and the Hobbyist.

[17] Reblitz, Arthur A. Piano Servicing, Tuning, and Rebuilding. For the Professional, the student, and the Hobbyist. Vestal Press, Lanham Maryland. 1993. ISBN 1-879511-03-7 Pp. 203-215.

References

- The authoritative *New Grove Dictionary of Music and Musicians* (available online by subscription), contains a wealth of information. Main article: "Pianoforte".
- The *Encyclopædia Britannica* (available online by subscription) also includes much information on the piano. In the 1988 edition, the primary article can be found in "Musical Instruments".
- The Piano Book by Larry Fine (4th ed. Jamaica Plain, Massachusetts: Brookside Press, 2001; ISBN 1-929145-01-2) gives the basics of how pianos work, and a thorough evaluative survey of current pianos and their manufacturers. It also includes advice on buying and owning pianos.
- *Giraffes, black dragons, and other pianos: a technological history from Cristofori to the modern concert grand* by Edwin M. Good (1982, second ed., 2001, Stanford, Calif.: Stanford University Press) is a standard reference on the history of the piano.
- *The Early Pianoforte* by Stewart Pollens (1995, Cambridge: Cambridge University Press) is an authoritative work covering the ancestry of the piano, its invention by Cristofori, and the early stages of its subsequent evolution.

Further reading

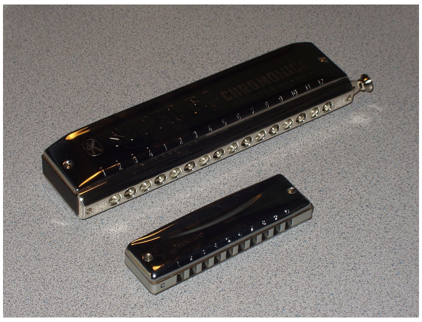
- Schejtman, Rod (2008). *Music Fundamentals* (http://www.pianoencyclopedia.com). The Piano Encyclopedia. ISBN 978-987-25216-2-2.
- Banowetz, Joseph; Elder, Dean (1985). *The pianist's guide to pedaling*. Bloomington: Indiana University Press. ISBN 0-253-34494-8.
- Carhart, Thad (2002) [2001]. *The Piano Shop on the Left Bank*. New York: Random House. ISBN 0-375-75862-3.
- Fine, Larry; Gilbert, Douglas R (2001). *The Piano Book: Buying and Owning a New or Used Piano (4th edition)* (http://pianobook.com). Jamaica Plain, MA: Brookside Press. ISBN 1-929145-01-2.
- Lelie, Christo (1995). *Van Piano tot Forte (The History of the Early Piano)*. Kampen: Kok-Lyra. (**Dutch**)
- Loesser, Arthur (1991) [1954]. *Men, Women, and Pianos: A Social History*. New York: Dover Publications.
- Parakilas, James (1999). *Piano roles : three hundred years of life with the piano*. New Haven, Connecticut: Yale University Press. ISBN 0-300-08055-7.
- Reblitz, Arthur A. (1993). *Piano Servicing, Tuning and Rebuilding: For the Professional, the Student, and the Hobbyist*. Vestal, NY: Vestal Press. ISBN 1-879511-03-7.

External links

- The Piano Page (http://www.ptg.org/)
- History of the Piano Forte (http://www.uk-piano.org/history/history.html), Association of Blind Piano Tuners, UK
- The Frederick Historical Piano Collection (http://www.frederickcollection.org/collection.html)
- The Pianofortes of Bartolomeo Cristofori, Heilbrunn Timeline of Art History, The Metropolitan Museum of Art (http://www.metmuseum.org/toah/hd/cris/hd_cris.htm)
- Piano Reviews (http://www.piano-reviews.net)

Harmonica

Harmonica



A 16-hole chromatic (top) and 10-hole diatonic harmonica

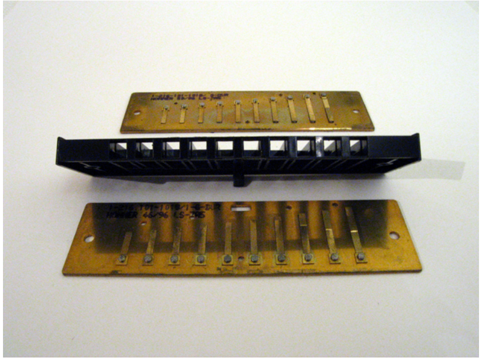
Other instrument	
Classification	• Wind • Free reed • Aerophone
Hornbostel-Sachs classification	412.132 (Free-reed aerophone)
Developed	Early 19th century
Playing range	
For 64-reeds (16-holes) chromatic harmonica: C below Middle C (C) to the D above C5; slightly over 4 octaves	
Related instruments	
melodeon, melodica, Yu	
More articles	
List of harmonicists	

The **harmonica**, also called harp, French harp, blues harp, and mouth organ,[1] is a free reed wind instrument used primarily in blues and American folk music, jazz, country music, and rock and roll. It is played by blowing air into it or drawing air out by placing lips over individual holes (reed chambers) or multiple holes. The pressure caused by blowing or drawing air into the reed chambers causes a reed or multiple reeds to vibrate up and down creating sound. Each chamber has multiple, variable-tuned brass or bronze reeds, which are secured at one end and loose on the other end, with the loose end vibrating and creating sound.

Reeds are pre-tuned to individual tones, and each tone is determined according to the size of reed. Longer reeds make deep, low sounds and short reeds make higher-pitched sounds. On certain types of harmonica the pre-tuned reed can be changed (bending a note) to another note by redirecting air flow into the chamber. There are many types of harmonicas, including diatonic, chromatic, tremolo, orchestral, and bass versions.

Parts

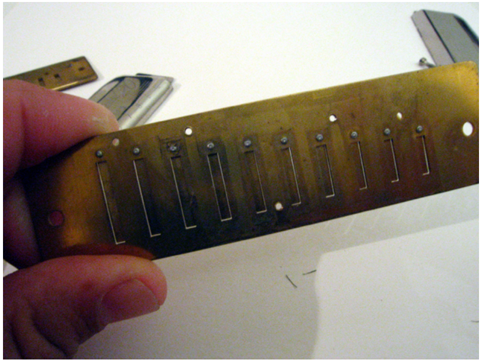
The basic parts of the harmonica are the *comb*, *reed-plates* and *cover-plates*.



Comb and two reedplates.

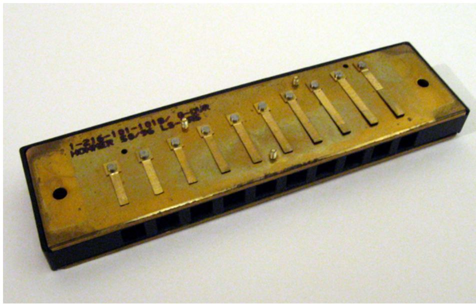
Comb

The comb is the term for the main body of the instrument, which contains the air chambers that cover the reeds. The term *comb* originates from the similarities between simple harmonicas and a hair comb. Harmonica combs were traditionally made from wood, but now are usually made from plastic (ABS) or metal (including titanium for very high-end instruments).[2] Some modern and experimental comb designs are complex in the way that they direct the air.



Reed plate.

Comb material was assumed to have an effect on the tone of the harp. While the comb material does have a slight influence over the sound of the harmonica, the main advantage of a particular comb material over another one is its durability.[3] In particular, a wooden comb can absorb moisture from the player's breath and contact with the tongue. This causes the comb to expand slightly, making the instrument uncomfortable to play. Various types of wood and treatments have been devised to reduce the degree of this problem.[2]



Reedplate mounted on the comb of a diatonic harmonica.

An even more serious problem with wood combs, especially in chromatic harmonicas (with their thin dividers between chambers) is that the combs shrink over time. Comb shrinkage can lead to cracks in the combs due to the combs being held immobile by nails, resulting in disabling leakage. Much effort is devoted by serious players to restoring wood combs and sealing leaks. Some players used to soak wooden-combed harmonicas (diatonics, without windsavers) in water to cause a slight expansion, which they intended to make the seal between the comb, reed plates and covers more airtight. Modern wooden-combed harmonicas are less prone to swelling and contracting. Players still dip harmonicas in water for the way it affects tone and ease of bending notes.

Reed-plate

Reed-plate is the term for a grouping of several reeds in a single housing. The reeds are usually made of brass, but steel, aluminium and plastic are occasionally used. Individual reeds are usually riveted to the reed-plate, but they may also be welded or screwed in place. Reeds fixed on the inside (within the comb's air chamber) of the reed-plate respond to blowing, while those on the outside respond to suction.

Most harmonicas are constructed with the reed-plates screwed or bolted to the comb or each other. A few brands still use the traditional method of nailing the reed-plates to the comb. Some experimental and rare harmonicas also have had the reed-plates held in place by tension, such as the WWII era all-American models. If the plates are bolted to the comb, the reed plates can be replaced individually. This is useful because the reeds eventually go out of tune through normal use, and certain notes of the scale can fail more quickly than others.

A notable exception to the traditional reed-plate design is the all-plastic harmonicas designed by Finn Magnus in the 1950s, where the reed and reed-plate were molded out of a single piece of plastic. The Magnus design had the reeds, reed-plates and comb made of plastic and either molded or permanently glued together.

Cover plates

Cover plates cover the reed-plates and are usually made of metal, though wood and plastic have also been used. The choice of these is personal — because they project sound, they determine the tonal quality of the harmonica. There are two types of cover plates: traditional open designs of stamped metal or plastic, which are simply there to be held, and enclosed designs (such as the Hohner Meisterklasse and Super 64, Suzuki Promaster and SCX), which offer a louder tonal quality. From these two basic types, a few modern designs have been created, such as the Hohner CBH-2016 chromatic and the Suzuki Overdrive diatonic, which have complex covers that allow for specific functions not usually available in the traditional design. It was not unusual in the late 19th and early 20th centuries to see harmonicas with special features on the covers, such as bells, which could be rung by pushing a button.

Windsavers

Windsavers are one-way valves made from thin strips of plastic, knit paper, leather or teflon glued onto the reed-plate. They are typically found in chromatic harmonicas, chord harmonicas and many octave-tuned harmonicas. Windsavers are used when two reeds share a cell and leakage through the non-playing reed would be significant. For example, when a draw note is played, the valve on the blow reed-slot is sucked shut, preventing air from leaking through the inactive blow reed. An exception to this is the recent Hohner XB-40 where valves are placed not to isolate single reeds but rather to isolate entire chambers from being active.

Mouthpiece

The mouthpiece is placed between the air chambers of the instrument and the player's mouth. This can be integral with the comb (the diatonic harmonicas, the Hohner Chrometta), part of the cover (as in Hohner's CX-12), or may be a separate unit entirely, secured by screws, which is typical of chromatics. In many harmonicas, the mouthpiece is purely an ergonomic aid designed to make playing more comfortable. However, in the traditional slider-based chromatic harmonica it is essential to the functioning of the instrument because it provides a groove for the slide.

Accessories

Amplification devices

Mark Wenner cups his hands around a "bullet mic" as he plays amplified harmonica.

Since the 1950s, many blues harmonica players have amplified their instrument with microphones and tube amplifiers. One of the early innovators of this approach was Marion "Little Walter" Jacobs, who played the harmonica near a "Bullet" microphone marketed for use by radio taxi dispatchers. This gave his harmonica tone a "punchy" mid-range sound that could be heard above an electric guitar. As well, tube amplifiers produce a natural distortion when played at higher volumes, which adds body and fullness to the sound. Little Walter also cupped his hands around the instrument, tightening the air around the harp, giving it a powerful, distorted sound, somewhat reminiscent of a saxophone, hence the term "Mississippi saxophone".

Rack or holder

Harmonica players who play the instrument while performing on another instrument with their hands (e.g., an acoustic guitar) often use an accessory called a "neck rack" or holder to position the instrument in front of their mouth. A harmonica holder clamps the harmonica between two metal brackets, which are attached to a curved loop of metal that rests on the shoulders. This device is used by folk musicians, "one man bands" and singer/songwriters such as Bob Dylan, Tom Harmon, Neil Young, Eddie Vedder, Bruce Springsteen and blues singers Jimmy Reed and John Hammond Jr..

Harmonica types

Chromatic harmonica

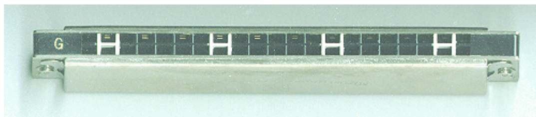
Hohner Super Chromonica, a typical 12-hole chromatic.

The chromatic harmonica usually uses a button-activated sliding bar to redirect air from the hole in the mouthpiece to the selected reed-plate, although there was one design, the "Machino-Tone," which controlled airflow by means of a lever-operated movable flap on the rear of the instrument. In addition, there is a "hands-free" modification of the Hohner 270 (12-hole) in which the player shifts the tones by moving the mouthpiece up and down with the lips, leaving the hands free to play another instrument. While the Richter-tuned 10-hole chromatic is intended to be played in only one key, the 12-, 14-, and 16-hole models (which are tuned to equal temperament) allow the musician to play in any key desired with only one harmonica. This harp can be used for any style, including Celtic, classical, jazz, or blues (commonly in third position).

Diatonic harmonicas

Strictly speaking, "diatonic" denotes **any** harmonica that is designed for playing in only one key (though the standard "Richter-tuned" diatonic can be played in other keys by forcing its reeds to play tones that are not part of its basic scale; see Blues harp). Depending on the region of the world, "diatonic harmonica" may mean either the tremolo harmonica (in East Asia) or blues harp (In Europe and North America). Other diatonic harmonicas include octave harmonica.

Tremolo harmonica



A tremolo harmonica.

The tremolo harmonica's distinguishing feature is that it has two reeds per note, with one slightly sharp and the other slightly flat. This provides a unique wavering or warbling sound created by the two reeds being slightly out of tune with each other and the difference in their subsequent waveforms interacting with each other (its beat). The Asian version, on which all 12 semitones can be played, is used in a large amount of East-Asian music, from rock to pop music.

Orchestral harmonicas

These harmonicas are primarily designed for use in ensemble playing.

Orchestral melody harmonica

There are eight kinds of orchestral melody harmonica: the most common are the **Horn** harmonicas that are most often found in East Asia. These consist of a single large comb with blow only reed-plates on the top and bottom. Each reed sits inside a single cell in the comb. One version mimics the layout of a piano or mallet instrument, with the natural notes of a C diatonic scale in the lower reed-plate and the sharps/flats in the upper reed-plate in groups of two and three holes with gaps in between like the black keys of a piano (thus there is no E#/Fb hole nor a B#/Cb hole on the upper reed-plate). Another version has one "sharp" reed directly above its "natural" on the lower plate, with the same number of reeds on both plates.

"Horn harmonicas" are available in several pitch ranges, with the lowest pitched starting two octaves below middle C and the highest beginning on middle C itself; they usually cover a two or three octave range. They are chromatic instruments and are usually played in an East Asian harmonica orchestra instead of the "push-button" chromatic harmonica that is more common in the European/American tradition. Their reeds are often larger, and the enclosing "horn" gives them a different timbre, so that they often function in place of a brass section. In the past, they were referred to as horn harmonicas.

The other type of orchestral melodic harmonica is the Polyphonia, (though some are marked "Chromatica"). These have all twelve chromatic notes laid out on the same row. In most cases, they have both blow and draw of the same tone, though the No. 7 is blow only, and the No. 261, also blow only, has two reeds per hole, tuned an octave apart (all these designations refer to products of M. Hohner).

Chord harmonica

The chord harmonica has up to 48 chords: major, seventh, minor, augmented and diminished for ensemble playing. It is laid out in four-note clusters, each sounding a different chord on inhaling or exhaling. Typically each hole has two reeds for each note, tuned to one octave of each other. However, less expensive models often have only one reed per note. Quite a few orchestra harmonicas are also designed to serve as both bass and chord harmonica, with bass notes next to chord groupings. There are also other chord harmonicas, such as the Chordomonica (which operates similar to a chromatic harmonica), and the junior chord harmonicas (which typically provides 6 chords).

ChengGong harmonica

The ChengGong 程功 harmonica[4] has a main body, and a sliding mouthpiece. The body is a 24-hole diatonic harmonica that starts from b2 to d6 (covering 3 octaves). Its 11-hole mouthpiece can slide along the front of the harmonica, which gives numerous chord choices and voicings (seven triads, three 6th chords, seven 7th chords, and seven 9th chords, for a total of 24 chords). As well, it is capable of playing single- note melodies and double stops over a range of three diatonic octaves. Unlike conventional harmonicas, blowing and drawing produce the same notes because its tuning is closer to the note layout of a typical Asian tremolo harmonica or the Polyphonias.[5]

Pitch pipe

The pitch pipe is a simple specialty harmonica that provides a reference pitch to singers and other instruments. The only difference between some early pitch-pipes and harmonicas is the name of the instrument, which reflected the maker's target audience. Chromatic pitch pipes, which are used by singers and choirs, give a full chromatic (12-note) octave. Pitch pipes are also sold for string players, such as violinists and guitarists; these pitch pipes usually provide the notes corresponding to the open strings.

Harmonica techniques

'Vibrato' is a technique commonly used while playing the harmonica and many other instruments,to give the note a 'shaking' sound. This technique can be accomplished in a number of ways. The most common way is to change how the harmonica is held. For example, by opening and closing your hands around the harmonica very rapidly you achieve the vibrato effect. Another way is to use a **'head shaking**' technique, frequently used in blues harmonica, in which the player moves the lips between two holes very quickly. This gives a quick shaking technique that is slightly more than vibrato and achieves the same aural effect on sustained notes. The vibrato might also be achieved via rapid glottal (vocal fold) opening and closing, especially on draws (inhalation) simultaneous to bending, or without bending. This obviates the need for cupping and waving the hands around the instrument during play.

In addition to the 19 notes readily available on the diatonic harmonica, players can play other notes by adjusting their embouchure and forcing the reed to resonate at a different pitch. This technique is called **bending**, a term possibly borrowed from guitarists, who literally "bend" a string to subtly change the pitch. Bending also creates the glissandos characteristic of much blues harp and country harmonica playing. Bends are essential for most blues and rock harmonica due to the soulful sounds the instrument can bring out. The"wail" of the blues harp typically required bending. In the 1970s, Howard Levy developed the **overbending** technique (also known as "overblowing" and "overdrawing".) Overbending, combined with bending, allowed players to play the entire chromatic scale.

In addition to playing the diatonic harmonica in its original key, it is also possible to play it in other keys by playing in other "positions" using different keynotes. Using just the basic notes on the instrument would mean playing in a specific mode for each position. Harmonica players (especially blues players) have developed terminology around different "positions," which can be confusing to other musicians.

Another technique, seldom used to its full potential, is altering the size of the mouth cavity to emphasize certain natural overtones. When this technique is employed whilst playing chords, care must be taken in overtone selection as the overtones stemming from the non-root pitch can cause extreme dissonance.

Harmonica players who amplified their instrument with microphones and tube amplifiers, such as blues harp players, also have a range of techniques that exploit the properties of the microphone and the amplifier, such as changing the way the hands are cupped around the instrument and the microphone or rhythmically breathing or chanting into the microphone while playing. Blues and folk players refer to the instrument with a range of less-common names including: *hand reed, Mississippi saxophone, licking stick, pocket sax, toe pickle, tin sandwich, ten-holed tin-can tongue twister,* and *French Harp*.

History

The harmonica was developed in Europe in the early part of the 19th century. Free reed instruments like the sheng were fairly common throughout East Asia for centuries and were relatively well-known in Europe for some time. Around 1820, free reed designs began being created in Europe. While Christian Friedrich Ludwig Buschmann is often cited as the inventor of the harmonica in 1821, other inventors developed similar instruments at the same time.[6] Mouth-blown free reed instruments appeared in the United States, South America, the United Kingdom and in Europe at roughly the same time.

Early instruments

The harmonica first appeared in Vienna, where harmonicas with chambers were sold before 1824 (see also Anton Reinlein and Anton Haeckl). Richter tuning, invented by Joseph Richter (who also is credited with inventing the blow and draw mechanism), was created in 1826 and was adopted nearly universally in the subsequent years. In Germany, Mr. Meisel of Geschichte des Akkordeonbaus in Klingenthal, Schwarzmeisel and Langhammer, bought a harmonica with chambers (Kanzellen) at the Exhibition in Braunschweig in 1824. He and Langhammer in Graslitz copied the instruments; by 1827 they had produced hundreds of harmonicas. Many others followed in Germany and also nearby in what would later become Czechoslovakia. In 1829, Johann Wilhelm Rudolph Glier also began making harmonicas.

In 1830, Christan Messner, a cloth maker and weaver from Trossingen, copied a harmonica his neighbour had brought from Vienna. He had such success that eventually his brother and some relatives also started to make harmonicas. From 1840 onwards, his nephew Christian Weiss was also involved in the business. By 1855, there were at least three harmonica-making businesses: C. A. Seydel Söhne, Christian Messner & Co., and Württ. Harmonikafabrik Ch. WEISS. Currently, only C.A. Seydel is still in business.

Owing to competition between the harmonica factories in Trossingen and Klingenthal, machines were invented to punch the covers for the reeds. In 1857, Matthias Hohner, a clockmaker from Trossingen, started producing harmonicas, eventually to become the first person to mass-produce them. He used a mass-produced wooden comb that he had made by machine-cutting firms. By 1868, he began supplying the United States. By the 1920s, the diatonic harmonica had largely reached its modern form. Other types followed soon thereafter, including the various tremolo and octave harmonicas.

By the late 19th century, harmonica production was a big business, having evolved into mass-production. New designs were still developed in the 20th century, including the chromatic harmonica, first made by Hohner in 1924, the bass harmonica, and the chord harmonica. In the 21st century, radical new designs are still being introduced into the market, such as the Suzuki Overdrive, Hohner XB-40, and Harrison B-Radical.

Diatonic harmonicas were designed primarily for the playing of German and other European folk music and have succeeded well in those styles. Over time the basic design and tuning proved adaptable to other types of music such as the blues, country, old-time and more. The harmonica was a success almost from the very start of production, and while the centre of the harmonica business has shifted from Germany, the output of the various harmonica manufacturers is still very high. Major companies are now found in Germany (Seydel, Hohner - the dominant manufacturer in the world), Japan (Suzuki, Tombo, Yamaha), China (Huang, Leo Shi, Suzuki, Hohner), Brasil (Hering, Bends) and the United States Harrison Harmonicas. Recently, responding to increasingly demanding performance techniques, the market for high quality instruments has grown.

Europe and North America

Early use

Shortly after Hohner began manufacturing harmonicas in 1857, he shipped some to relatives who had emigrated to the United States. Its music rapidly became popular, and the country became an enormous market for Hohner's goods. President Abraham Lincoln carried a harmonica in his pocket,[7] and harmonicas provided solace to soldiers on both the Union and Confederate sides of the American Civil War. Frontiersmen Wyatt Earp and Billy the Kid played the instrument, and it became a fixture of the American musical landscape.

The first recordings of harmonicas were made in the U.S. in the 1920s. These recordings are 'race-records', intended for the black market of the southern states with solo recordings by DeFord Bailey, duo recordings with a guitarist Hammie Nixon, Walter Horton, Sonny Terry, as well as hillbilly styles recorded for white audiences, by Frank Hutchison, Gwen Foster and several other musicians. There are also recordings featuring the harmonica in jug bands, of which the Memphis Jug Band is the most famous. But the harmonica still represented a toy instrument in those years and was associated with the poor. It is also during those years that musicians started experimenting with new techniques such as tongue-blocking, hand effects and the most important innovation of all, the 2nd position, or cross-harp.

The harmonica's versatility brought it to the attention of classical music during the 1930s. American Larry Adler was one of the first harmonica players to perform major works written for the instrument by the composers Ralph Vaughan Williams, Malcolm Arnold, Darius Milhaud and Arthur Benjamin.

The United States experienced a shortage of harmonicas during World War II. Wood and metal materials that were used for harmonicas were in short supply due to military demand. Furthermore, the primary manufacturers of harmonicas were based in Germany and Japan, who happened to be the Axis powers opposed to the United States and the allied forces in the war. It was during this time that Finn Harkon Magnus, a Dutch-American factory worker and entrepreneur, developed and perfected the molded-plastic harmonica. The plastic harmonica used molded plastic combs and far fewer pieces than traditional metal or wood harmonicas, which as a result made the harmonica more sanitary and far more economical to mass produce. Though these harmonicas produced a less distinctive (and, to many ears, inferior) sound than their metallic counterparts, Magnus harmonicas, as well as several imitators, soon became commonplace, particularly among children.[8]

1950s blues players

The harmonica then made its way with the blues and the black migrants to the north, mainly to Chicago but also to Detroit, St. Louis and New York. The music played by African Americans increasingly began to use electric amplification for the guitar, harp, double bass, and a crude PA system for the vocals. Alec Rice Miller, better known as Sonny Boy Williamson II, is one of the important harmonicists of this era. Using a full blues band, he became a popular act in the South with his daily broadcasts on the 'King Biscuit Time', originating live from Helena, Arkansas. He also helped to popularize the cross-harp technique, which became an important blues harmonica technique.

A young harmonicist named Marion "Little Walter" Jacobs revolutionized the instrument by playing the harmonica with a microphone (typically a "Bullet" microphone marketed for use by radio taxi dispatchers cupped in his hands with the harmonica, giving it a "punchy" mid-range sound that can be heard above radio static, or an electric guitar). He cupped his hands around the instrument, tightening the air around the harp, giving it a powerful, distorted sound, somewhat reminiscent of a saxophone.

Big Walter Horton was the favored harmonicist of many Chicago blues bandleaders, including Willie Dixon. His colorful solos used the full register of his instrument and some chromatic harmonicas. Howlin' Wolf's early recordings demonstrate great skill, particularly at blowing powerful riffs with the instrument. Sonny Boy Williamson II used the possibilities of hand effects to give a talkative feel to his harp playing. Williamson extended his influence on the young British blues rockers in the 1960s, recording with Eric Clapton and The Yardbirds and appearing on

live British television. Stevie Wonder learned harmonica at age 5 and plays the instrument on many of his recordings. Jimmy Reed played harmonica on most of his blues shuffle recordings.

1960s and 1970s blues players

The 1960s and 1970s saw the harmonica become less prominent, as the overdriven electric lead guitar became the dominant instrument for solos in blues rock. Paul Butterfield is a well known harp player of the era in the blues and blues-rock arena. Heavily influenced by Little Walter, he pushed further the virtuosity on the harp. Chicago harmonica player James Cotton specialized in slow, magnificent note-bends.

Blues harmonica players who are primarily or mainly associated with the instrument include Norton Buffalo, Jerry Portnoy, Lazy Lester, Bob Dylan, Rabini Zami, Sugar Blue, Billy Branch, Charlie Musselwhite, Corky Siegel, Junior Wells, Kim Wilson, Slim Harpo, Al "Blind Owl" Wilson of Canned Heat, Jack Bruce of Cream and John Sebastian of The Lovin' Spoonful.

Musicians who are primarily known as singers or performers on another instrument who also have recorded and performed harmonica solos include Bruce Springsteen, Donovan, Taj Mahal, Mick Jagger and Brian Jones of The Rolling Stones, Huey Lewis of Huey Lewis and the News, John Mayall, Peter Green of (the original) Fleetwood Mac, Roger Daltrey of The Who, Steven Tyler of Aerosmith, Robert Plant of Led Zeppelin, Bono of U2, and Richard "Magic Dick" Salwitz of The J. Geils Band. Billy Joel famously plays the harmonica, in addition to his piano, on his signature song, "Piano Man". includes the harmonica throughout the piece. John Lennon played harmonica on early hits as "Love Me Do", "Please Please Me", "I'll Get You" and "I Should Have Known Better" and in his solo career on songs such as "Oh Yoko!".

2000s blues players

Contemporary harmonicists Howard Levy, Chris Michalek, Jason Ricci, and Carlos del Junco have pushed the envelope of the instrument. Levy explored and pioneered the over blow technique in the early seventies, which enables the diatonic harmonica to play full chromatic scales across three octaves, while retaining the particular sound of the harp. Overblowing is used by Howard Levy, Frédéric Yonnet, Adam Gussow, Chris Michalek, Paul Nebenzahl, and Jason Ricci and Carlos del Junco are starting to integrate it in a more blues or rock oriented music. Richard "Magic Dick" Salwitz, Billy Branch, John Popper, Tom Ball, "Dirty" Patrick Walsh, Big Dave Perea, Joe Filisko, Miles Ryan and others are keeping the harmonica tradition alive. Peter Doherty of The Libertines and Babyshambles has also been known to use a harmonica especially during songs such as Albion and Killamangiro.

Other styles and regions

European harmonica player Philip Achille, who performs Irish, Classical, Jazz, Qawali and sufi music, has won jazz competitions and his classical performances have led to appearances on the BBC as well as ITV and Channel 4. Performers include French harmonicist Nikki Gadout, and Germans Steve Baker and the late Johnny Müller (who played the title melody of the Winnetou-movies). The Brazilian Flávio Guimarães performs a variety of styles. From France Yvonnick Prene plays jazz on chromatic harmonica.

In Nashville, P. T. Gazell has an influential style, as does Charlie McCoy, an American music harmonicist. Irish stylists include John and Pip Murphy, Noel Battle, Austin Berry, James Conway, Andy Irvine, Mick Kinsella, Brendan Power, Joel Bernstein, Don Meade, Paul Moran and Rick Epping. Peter "Madcat" Ruth maintains a website [9] that links to the sites of contemporary players around the world. Wade Schuman, founder of the group Hazmat Modine, has fused overblowing with older traditional styles and middle European harmonies.

East Asia

In 1898, the harmonica was brought to Japan, where the Tremolo harmonica was the most popular instrument. After about 30 years, the Japanese developed scale tuning and semitone harmonicas to be able to perform Japanese folk songs.

Harmonica music started to develop in Hong Kong in the 1930s. Individual tremolo harmonica players from China moved to Hong Kong to set up different harmonica organizations such as The Chinese Y.M.C.A. Harmonica Orchestra, the China Harmonica Society,[10] and the Heart String Harmonica Society. In the 1950s, chromatic harmonica became popular in Hong Kong, and players such as Larry Adler and John Sebastian were invited to perform.

Local players such as Lau Mok (劉牧) and Fung On (馮安) promoted the chromatic harmonica. In the Chinese Y.M.C.A. Harmonica Orchestra, the chromatic harmonica gradually became the main instrument. The Chinese YMCA Harmonica Orchestra started in the 1960s, with 100 members, most of whom played harmonicas.[11] Non-harmonica instruments were also used, such as double bass, accordion, piano, and percussion such as timpani and xylophone.

In the 1970s, the Haletone Harmonica Orchestra (曉彤口琴隊)[12] was set up at Wong Tai Sin Community Centre. Fung On and others continued to teach harmonica and also set up harmonica orchestras. In the 1980s, the number of harmonica learners decreased steadily. In the 1990s, harmonica players in Hong Kong began to participate in international harmonica competitions, including the World Harmonica Festival in Germany and the Asia Pacific Harmonica Festival. In the 2000s, the Hong Kong Harmonica Association (H.K.H.A.) (香港口琴協會)[13] was established.

The history of the harmonica in Taiwan began around 1945. By the 1980s, though, as living standards increased, many instruments that were once too expensive to buy could be bought by the Taiwanese in preference to the harmonica.

Medical use

Playing the harmonica requires inhaling and exhaling strongly against resistance. This action helps develop a strong diaphragm and deep breathing using the entire lung volume. Pulmonary specialists have noted that playing the harmonica resembles the kind of exercise used to rehabilitate COPD patients such as using a PFLEX inspiratory muscle trainer or the inspiratory spirometer. Learning to play a musical instrument also offers motivation in addition to the exercise component. Many pulmonary rehabilitation programs therefore have begun to incorporate the harmonica.[14] [15] [16] [17] Harmonicist Frédéric Yonnet suffered from childhood asthma and credits the harmonica for helping him manage his asthma through adulthood.

Competitions

The World Harmonica Festival is held in the autumn every four years in Trossingen, Germany, home of the Hohner harmonica company. The last World Harmonica Festival was in 2009, and a harmonica workshop is held every year.[18] The Asia Pacific Harmonica Festival is held regularly; in 2008 it was hosted by China.

In Hong Kong, Schools Music Festival is held every year for school students to compete in different music classes. Harmonica classes include band for primary and secondary schools, ensemble for secondary school, duet for secondary school, solo (junior, intermediate, and senior), and concert work (open).

Every August there is a harmonica contest in Idaho. The contest has been running since 1989. The contest is held in Yellow Pine about 150 miles outside of Boise, Idaho and is called the Yellow Pine Harmonica Contest.[19]

Related instruments

The concertina, diatonic and chromatic accordions and the melodica are all free-reed instruments that developed alongside the harmonica. Indeed, the similarities between harmonicas and so-called "diatonic" accordions or melodeons is such that in German the name for the former is "Mundharmonika" and the later "Handharmonika," which translate as "mouth harmonica" and "hand harmonica." In Scandinavian languages, an accordion is simply called "harmonika," whereas a harmonica is a "mundharmonika" (mouth harmonica). The names for the two instruments in the Slavic languages are also either similar or identical. The harmonica shares similarities to all other free-reed instruments by virtue of the method of sound production.

The glass harmonica has the word "harmonica" in its name, but it is not related to free-reed instruments. The glass harmonica is a musical instrument formed from a nested set of graduated glass cups mounted sideways on an axle. Each of the glass cups is tuned to a different note, and they are arranged in a scalar order. It is played by touching the rotating cups with wetted fingers, causing them to vibrate and produce a sustained "singing" tone.

Notation

Tabulature

Tabulature notation (often abbreviated as "tab") is a method of writing melodies by indicating where the notes are played on the instrument, rather than by indicating the pitches with circles and note heads printed on a staff, as with standard notation. One of the advantages of tab is that it can be easier for performers without formal training to learn, because the notation directly indicates where to play the note.

While tab is most often associated with fretted stringed instruments such as the guitar, tab is also used with other instruments such as the organ and harmonica.

There are many harmonica tab systems in use. A simple tab system appears as follows:

Diatonic Harmonica tab:

```
 2  = blow the 2 hole < Also: +2 >
-2  = draw the 2 hole
-2' = draw the 2 hole with a half bend < Also -2b >
-2" = draw the 2 hole with a full bend < Also -2bb>
```

Chords are shown by grouping notes with parentheses

(2 3) = blow the 2 hole and the 3 hole at the same time

Chromatic Harmonica tab:

```
  2 = blow the 2 hole
 -2 = draw the 2 hole
 <2 = blow the 2 hole with the button in
<-2 = draw the 2 hole with the button in
```

Text Tab[20] is another common type of harmonica tablature. It indicates when a player should "blow" or "draw" on a note by appending a letter suffix (B for blow or D for draw) to the appropriate harmonica hole number. Text Tab is used by harmonica instructors such as Dave Gage and Jon Gindick. It can be found on their websites and books and web forums.

Harmonica tab is usually aligned with lyrics to show the tune and the timing, and usually states the key of the harmonica required for the song.

Complete example of harmonica tab:

```
Cockles And Mussels (Molly Malone):
6  7  7     7    7 8   7     -8    -8  -8 -8  -9
In Dublin's fair city, where girls are so pretty,
-8 9    9   9  9     9  7     -8 8  7 -8
I first set my sight on sweet Molly Malone.
6   7   7 7   7  8    7   -8    -8     -8 -9
She was a fishmonger, and she'd stroll along,
8   8    9  8    7   9  8     7 -8   8 -8   7
Singing "Cockles And Mussels, Alive, Alive, Oh."
6 7   7 7   -8 8  7 -8  -8 -8 -8 8
Alive alive oh-oh Alive alive oh-oh
7   7   9   8   7   9  8    7 -8  8 -8  7
Singing Cockles and Mussels alive alive oh
```

Regular notation

Below the sheet music manuscript, there will be the number (sometimes inside a circle) with an arrow beneath that number. An upwards arrow means to blow, and a downwards arrow means to draw. Bend notes will have a curved arrow, slightly to the left for a flat half tone, and a long one for a full bend. (For a sharp bend, the arrows will point to the right).

Real music notation and harmonica education

The use of harmonica in public school systems required the use of real music notes, such as is used with all other instruments. Until the mid 1990s, there were no instruction methods that taught using real music notation. With the publication of The Perfect Harmonica Method by Jerry Perelman, harmonica was now officially a recognized instrument in the New York City school system. Thousands of students learned to play and numerous other schools throughout the world have incorporated this method into their general music programs. To date, there is still no other harmonica method approved by the New York Department of Education for use as a textbook in their schools.

References

Notes

[1] Willy, B. "Harmonica 101" (http://www.davidpatrone.com/Literature/Harmonica101.htm). .
[2] " Mark Lavoie - Harmonica Player ... and more (http://middlebury.net/interesting/lavoie.html)," *The Middlebury Community Network*
[3] Weinstein, Randy F. and William Melton. *The Complete Idiot's Guide to Playing the Harmonica*. ISBN 0028642414.
[4] (a pun on the inventor's surname and 成功, or "success," pronounced "chenggong" in Mandarin Chinese) harmonica, invented by Cheng Xuexue 程雪學 of China.
[5] Missin, P. "ChengGong harmonica" (http://www.patmissin.com/gallery/gallery03.html). .
[6] Conny Restle: In aller Munde, S. 43, Staatl. Institut für Musikforschung, Berlin 2003.
[7] http://www.hohnerusa.com/ahistory.htm
[8] http://books.google.com/books?id=YyEDAAAAMBAJ&pg=RA1-PA244&lpg=RA1-PA244&dq=Finn+Haakon+Magnus&source=bl&ots=kYehT3zxkD&sig=FBKN1OxaVI_PhJEjOZGp0qbPJuc&hl=en&ei=ELIXTIeKFsG88ga_5JytCQ&sa=X&oi=book_result&ct=result&resnum=4&ved=0CCAQ6AEwAw#v=onepage&q=Finn%20Haakon%20Magnus&f=false
[9] http://www.madcatmusic.net/links.html
[10] (中國口琴社)
[11] The violin and viola were replaced by 12-hole and 16-hole chromonicas; cello by chord harmonica, contra bass and octave bass; double bass by octave bass; flute by pipe soprano; clarinet by pipe alto; trumpet by horn soprano; trombone by horn alto; oboe by melodica soprano; English horn by melodica alto; French horn by melodica professional.
[12] http://www.haletone.com/introeng.html
[13] http://www.hkharmonica.org/index.php
[14] "Harmonica For Fun & Health Classes" (http://www.harmonicamasterclass.com/pulm.htm). Harmonica Masterclass. .

[15] University of Michigan (September 28, 2005). "When breathing needs a tune-up, harmonica class hits all the right notes" (http://www.med.umich.edu/opm/newspage/2005/hmharmonica.htm). Press release. .
[16] "Pulmonologists Treat Breath Shortness with Harmonica Classes" (http://www.aip.org/dbis/stories/2006/15114.html). American Institute of Physics. January 1, 2006. .
[17] "Using the Harmonica in Physical Therapy. (This will be useful in cheerleading practice.)" (http://www.kyw1060.com/content_page.php?contentType=4&contentId=151980). KYW Newsradio 1060. .
[18] A report of the 2005 World Harmonica Festival by David Barrett (http://www.harmonicasessions.com/feb06/festival.html).
[19] Yellow Pine Harmonica Contest website (http://www.harmonicacontest.com).
[20] http://www.harmonicalessons.com/tabs.html

Sources

- http://www.prweb.com/releases/World/Record/prweb574418.htm
- http://www.guinnessworldrecords.com/records/arts_and_media/music_feats_and_facts/fastest_harmonica_player.aspx

External links

- Layout of 12 Keys of Richter-tuned Diatonic Harmonica (http://upload.wikimedia.org/wikipedia/commons/b/b1/HarpLayout.pdf)
- 12 Keys of Pentatonic Scales on one Richter-tuned Diatonic Harmonica in C (http://upload.wikimedia.org/wikipedia/commons/7/7e/CHARPPENT.pdf)
- HarmoPoint (http://harmopoint.com/) Diatonic harmonica initiation using a multi-media concept that allows you to visualize the playing
- Riccardo's Harmonica Tutorial (http://www.riccardos.org/harmonicas/) Free lessons on harmonica theory, positions, scales and chord structures.
- "Free shared harmonica links" (http://harmonica-world.over-blog.com) International harmonica weblinks grouped by theme
- Frequently Asked Question about harmonica playing (http://stagepass.com/faqharp.html) Questions about how to play harmonica
- "Mark Purintun's Harmonica Tutorial" (http://harpinanawhinin.com)
- The Tremolo: Learning to Play (http://thetremolo.ponderworthy.com/learning.html)

Cymbal

Cymbals are a common percussion instrument. Cymbals consist of thin, normally round plates of various alloys; see cymbal making for a discussion of their manufacture. The greater majority of cymbals are of indefinite pitch, although small disc-shaped cymbals based on ancient designs sound a definite note (see: crotales). Cymbals are used in many ensembles ranging from the orchestra, percussion ensembles, jazz bands, heavy metal bands, and marching groups. Drum kits usually incorporate a crash, ride or crash ride, and a pair of hi-hat cymbals.

A suspended cymbal.


Characteristic rock hi-hat pattern. play

Etymology

The word cymbal is derived from the Latin *cymbalum*, which is the latinisation of the Greek word κύμβαλον (*kumbalon*), "cymbal",[1] which in turn derives from κύμβος (*kumbos*), "cup".[2]

Anatomy


Ancient Greek bronze cymbal, 5th century BCE, National Archaeological Museum, Athens

The anatomy of the cymbal plays a large part in the sound it creates.[3] The hole is drilled in the center of the cymbal and it is used to either mount the cymbal on a stand or straps (for hand playing). The bell, dome, or cup is the raised section immediately surrounding the hole. The bell produces a higher "pinging" pitch than the rest of the cymbal. The bow is the rest of the surface surrounding the bell. The bow is sometimes described in two areas: the ride and crash area. The ride area is the thicker section closer to the bell while the crash area is the thinner tapering section near the edge. The edge or rim is the immediate circumference of the cymbal.

Cymbals are measured by their diameter often in inches or centimeters. The size of the cymbal affects its sound, larger cymbals usually being louder and having longer sustain. The weight describes how thick the cymbal is. Cymbal weights are important to the sound they produce and how they play. Heavier cymbals have a louder volume, more cut, and better stick articulation (when using drum sticks). Thin cymbals have a fuller sound, a lowered pitch, and faster response.

The profile of the cymbal is the vertical distance of the bow from the bottom of the bell to the cymbal edge (higher profile cymbals are more bowl shaped). The profile affects the pitch of the cymbal; Higher profile cymbals have higher pitch.

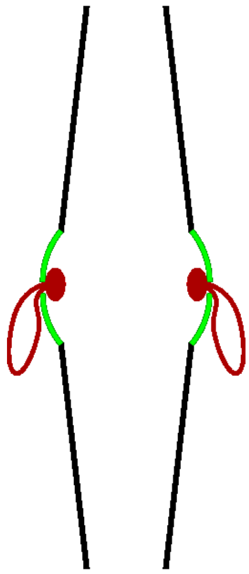
Types

Orchestral cymbals

Cymbals offer a composer nearly endless amounts of color and effect. Their unique timbre allows them to project even against a full orchestra and through the heaviest of orchestrations and enhance articulation and nearly any dynamic. Cymbals have been utilized historically to suggest frenzy, fury or bacchanalian revels, as seen in the Venus music in Wagner's *Tannhäuser*, Grieg's *Peer Gynt suite*, and Osmin's aria "O wie will ich triumphieren" from Mozart's *Die Entführung aus dem Serail*.

Clash cymbals

Orchestral clash cymbals are traditionally used in pairs, each one having a strap set in the bell of the cymbal by which they are held. Such a pair is also known as **crash cymbals** or plates.



A pair of clash cymbals in profile. The bell is in green and the straps are in red.

The sound can be obtained by rubbing their edges together in a sliding movement for a "sizzle", striking them against each other in what is called a "clash", tapping the edge of one against the body of the other in what is called a "tap-clash", scraping the edge of one from the inside of the bell to the edge for a "scrape" or "zischen," or shutting the cymbals together and choking the sound in what is called a "hi-hat chick" or crush. A skilled player can obtain an enormous dynamic range from such a pair of cymbals. For example, in Beethoven's ninth symphony, the percussionist is employed to first play cymbals at pianissimo, adding a touch of colour rather than loud clash.

Chinese style clash cymbals in use.

Clash cymbals are usually damped by pressing them against the player's body. A composer may write *laissez vibrer*, "Let vibrate" (usually abbreviated l.v.), *secco* (dry), or equivalent indications on the score; more usually, the player must judge exactly when to damp the cymbals based on the written duration of clash and the context in which it occurs.

Clash cymbals have traditionally been accompanied by the bass drum playing an identical part. This combination, played loudly, is an effective way to accentuate a note since the two instruments together contribute to both very low and very high frequency ranges and provide a satisfying "clash-bang-wallop". In older music the composer sometimes provided just one part for this pair of instruments, writing *senza piatti* or *piatti soli* (Italian: "without cymbals" or "cymbals only") if the bass drum is to remain silent. This came from the common practice of only having one percussionist play both instruments, using one cymbal mounted to the shell of the bass drum itself. The player would clash the cymbals with his left hand and use a mallet to strike the bass drum in his right. This method is often employed today in pit orchestras and is called

for specifically by composers who desire a certain effect. Stravinsky calls for this in his ballet Petrushka and Mahler calls for this in his Titan Symphony. However, the modern convention is for the instruments to have independent

parts.

Clash cymbals evolved into the low-sock and from this to the modern hi-hat. Even in a modern drum kit, they remain paired with the bass drum as the two instruments which are played with the player's feet. However, hi-hat cymbals tend to be heavy with little taper, more similar to a ride cymbal than to a clash cymbal as found in a drum kit, and perform a ride rather than a clash function.

Suspended cymbal

Another use of cymbals is the suspended cymbal. This instrument takes its name from the traditional method of suspending the cymbal by means of a leather strap or rope, thus allowing the cymbal to vibrate as freely as possible for maximum musical effect. Early jazz drumming pioneers borrowed this style of cymbal mounting during the early 1900s and later drummers further developed this instrument in to the mounted horizontal or nearly horizontally mounted "crash" cymbals of a modern drum kit, However, most modern drum kits do not employ a leather strap suspension system. Many modern drum kits use a mount with felt or otherwise dampening fabric to act as a barrier to hold the cymbals between metal clamps: thus forming the modern day ride cymbal.

Suspended cymbals can be played with yarn, sponge or cord wrapped mallets. The first known instance of using a sponge-headed mallet on a cymbal is the final chord of Hector Berlioz' Symphonie Fantastique. Composers sometimes specifically request other types of mallets like felt mallets or timpani beaters for different attack and sustain qualities.

Suspended cymbals can produce bright and slicing tones when forcefully struck, and give an eerie transparent "windy" sound when played quietly. A tremolo, or roll (played with two mallets alternately striking on opposing sides of the cymbal) can build in volume from almost inaudible to an overwhelming climax in a satisfyingly smooth manner (as in Humperdink's Mother Goose Suite).

The edge of a suspended cymbal may be hit with shoulder of a drum stick to obtain a sound somewhat akin to that of a pair of clash cymbals. Other methods of playing include scraping a coin or a triangle beater rapidly across the ridges on the top of the cymbal, giving a "zing" sound (as in the fourth movement of Dvořák's Symphony No. 9). Other effects that can be used include drawing a cello or bass bow across the edge of the cymbal for a sound not unlike squealing car brakes.

Ancient cymbals

Ancient cymbals or tuned cymbals are much more rarely called for. Their timbre is entirely different, more like that of small hand-bells or of the notes of the keyed harmonica. They are not struck full against each other, but by one of their edges, and the note given in by them is higher in proportion as they are thicker and smaller. Berlioz's *Romeo and Juliet* calls for two pairs of cymbals, modelled on some old Pompeian instruments no larger than the hand (some are no larger than a crown piece), and tuned to F and B flat. The modern instruments descended from this line are the crotales.

List of Cymbal Types

- Bell cymbal
- China cymbal
- Clash cymbal
- Crash cymbal
- Hi-hat
- Ride cymbal
- Sizzle cymbal
- Splash cymbal
- Swish cymbal
- Finger cymbal
- Taal

Hi-hats. The clutch suspends the top cymbal on a rod operated by a foot pedal.

References

- Chisholm, Hugh, ed (1911). "Cymbals". *Encyclopædia Britannica* (11th ed.). Cambridge University Press.

[1] κύμβαλον (http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.04.0057:entry=ku/mbalon), Henry George Liddell, Robert Scott, *A Greek-English Lexicon*, 1940, on Perseus Digital Library

[2] κύμβος (http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.04.0057:entry=ku/mbos), Henry George Liddell, Robert Scott, *A Greek-English Lexicon*, 1940, on Perseus Digital Library

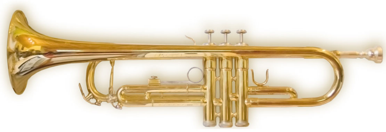
[3] Sabian.com education, Anatomy page http://sabian.com/EN/education/cymbal_anatomy.cfm

External links

- Cymbal Forum (http://www.cymbalforum.com) Discussion forum about cymbals.
- Saluda Cymbals (http://www.saludacymbals.com) World of Custom Cymbals
- CymbalPlanet.com (http://www.cymbalplanet.com) Welcome to the World of Cymbals
- Accessory Fetish (http://www.accessoryfetish.com/gear-links/drum-accessories/cymbals) A Complete List of Cymbal Manufacturers
- Orchestral cymbal playing (http://www.nexuspercussion.com/2009/04/crashes-splashes-strokes-and-rolls/#more-5275), with an excellent short history of cymbals
- Cymbal Colour Exploration (http://vimeo.com/19478267), A 3D binaural audio recording of different cymbal sound colours

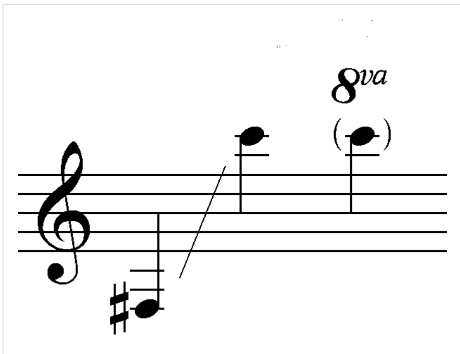
Trumpet

Trumpet



B♭ trumpet

Brass instrument	
Classification	Brass • Wind • Brass • Aerophone
Hornbostel-Sachs classification	423.233 (Valved aerophone sounded by lip movement)
Playing range	
Written range:	



Related instruments	
Flugelhorn, cornet, bugle, natural trumpet, bass trumpet, post horn, Roman tuba, bucina, shofar, conch, lur, didgeridoo, piccolo trumpet, baritone horn, pocket trumpet	

The **trumpet** is the musical instrument with the highest register in the brass family. Trumpets are among the oldest musical instruments,[1] dating back to at least 1500 BCE. They are constructed of brass tubing bent twice into a rounded oblong shape, and are played by blowing air through closed lips, producing a "buzzing" sound which starts a standing wave vibration in the air column inside the trumpet.

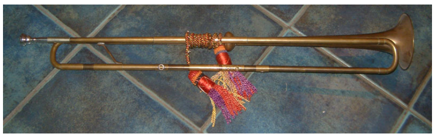
There are several types of trumpet; the most common is a transposing instrument pitched in B♭ with a tubing length of about 134 cm. The predecessors to trumpets did not have valves, but modern trumpets generally have either three piston valves or, more rarely, three rotary valves. Each valve increases the length of tubing when engaged, thereby lowering the pitch.

The trumpet is used in many forms of music, including classical music and jazz.

A musician who plays the trumpet is called a *trumpet player* or *trumpeter*.

History

Trumpet. 300 CE Larco Museum Collection Lima, Peru.



Reproduction Baroque trumpet by Michael Laird

The earliest trumpets date back to 1500 BCE and earlier. The bronze and silver trumpets from Tutankhamun's grave in Egypt, bronze lurs from Scandinavia, and metal trumpets from China date back to this period.[2] Trumpets from the Oxus civilization (3rd millennium BCE) of Central Asia have decorated swellings in the middle, yet are made out of one sheet of metal, which is considered a technical wonder.[3] The Moche people of ancient Peru depicted trumpets in their art going back to 300 CE.[4] The earliest trumpets were signaling instruments used for military or religious purposes, rather than music in the modern sense;[5] and the modern bugle continues this signaling tradition.

In medieval times, trumpet playing was a guarded craft, its instruction occurring only within highly selective guilds. The trumpet players were often among the most heavily guarded members of a troop, as they were relied upon to relay instructions to other sections of the army.

Improvements to instrument design and metal making in the late Middle Ages and Renaissance led to an increased usefulness of the trumpet as a musical instrument. The natural trumpets of this era consisted of a single coiled tube without valves and therefore could only produce the notes of a single overtone series. Changing keys required the player to swap out the crooks of the instrument. The development of the upper, "clarino" register by specialist trumpeters—notably Cesare Bendinelli—would lend itself well to the Baroque era, also known as the "Golden Age of the natural trumpet." During this period, a vast body of music was written for virtuoso trumpeters. The art was revived in the mid-20th century and natural trumpet playing is again a thriving art around the world. Most successful players nowadays use a version of the natural trumpet dubbed the baroque trumpet which is fitted with one or more vent holes to aid in correcting out-of-tune notes in the harmonic series.

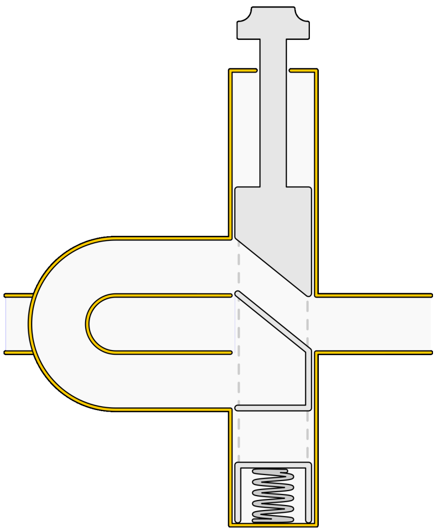
The melody-dominated homophony of the classical and romantic periods relegated the trumpet to a secondary role by most major composers owing to the limitations of the natural trumpet. Berlioz wrote in 1844:

> Notwithstanding the real loftiness and distinguished nature of its quality of tone, there are few instruments that have been more degraded (than the trumpet). Down to Beethoven and Weber, every composer - not excepting Mozart - persisted in confining it to the unworthy function of filling up, or in causing it to sound two or three commonplace rhythmical formulae.[6]

The attempt to give the trumpet more chromatic freedom in its range saw the development of the keyed trumpet, but this was a largely unsuccessful venture due to the poor quality of its sound.

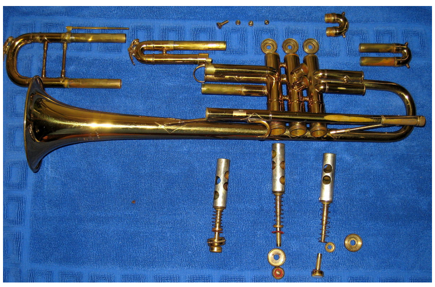
Although the impetus for a tubular valve began as early as 1793, it was not until 1818 that Friedrich Bluhmel and Heinrich Stölzel made a joint patent application for the box valve as manufactured by W. Schuster. The symphonies of Mozart, Beethoven, and as late as Brahms, were still played on natural trumpets. Crooks and shanks (removable tubing of various lengths) as opposed to keys or valves were standard, notably in France, into the first part of the 20th century. As a consequence of this late development of the instrument's chromatic ability, the repertoire for the instrument is relatively small compared to other instruments. The 20th century saw an explosion in the amount and variety of music written for the trumpet.

Construction


Trumpet valve bypass (depressed)

The trumpet is constructed of brass tubing bent twice into a rounded oblong shape.[7] The trumpet and trombone share a roughly cylindrical bore which results in a bright, loud sound. The bore is actually a complex series of tapers, smaller at the mouthpiece receiver and larger just before the flare of the bell begins; careful design of these tapers is critical to the intonation of the instrument. By comparison, the cornet and flugelhorn have conical bores and produce a more mellow tone. Bore sizes generally range from 0.430 to 0.472 inches and are usually listed as medium, medium large and large from various manufactuers.

As with all brass instruments, sound is produced by blowing air through closed lips, producing a "buzzing" sound into the mouthpiece and starting a standing wave vibration in the air column inside the trumpet. The player can select the pitch from a range of overtones or harmonics by changing the lip aperture and tension (known as the embouchure). The mouthpiece has a circular rim which provides a comfortable environment for the lips' vibration. Directly behind the rim is the cup, which channels the air into a much smaller opening (the back bore or shank) which tapers out slightly to match the diameter of the trumpet's lead pipe. The dimensions of these parts of the mouthpiece affect the timbre or quality of sound, the ease of playability, and player comfort. Generally, the wider and deeper the cup, the darker the sound and timbre.


B♭ trumpet disassembled

Modern trumpets have three (or infrequently four) piston valves, each of which increases the length of tubing when engaged, thereby lowering the pitch. The first valve lowers the instrument's pitch by a whole step (2 semitones), the second valve by a half step (1 semitone), and the third valve by one-and-a-half steps (3 semitones). When a fourth valve is present, as with some piccolo trumpets, it lowers the pitch a perfect fourth (5 semitones). Used singly and in combination these valves make the instrument fully chromatic, i.e., able to play all twelve pitches of classical music. For more information about the different types of valves, see Brass instrument valves.

The pitch of the trumpet can be raised or lowered by the use of the tuning slide. Pulling the slide out lowers the pitch; pushing the slide in raises it. To overcome the problems of intonation and reduce the use of the slide, Renold Schilke designed the tuning-bell trumpet. Removing the usual brace between the bell and a valve body allows the use of a sliding bell; the player may then tune the horn with the bell while leaving the slide pushed in, or nearly so,

thereby improving intonation and overall response.[8]

A trumpet becomes a closed tube when the player presses it to the lips; therefore, the instrument only naturally produces every other overtone of the harmonic series. The shape of the bell is what allows the missing overtones to be heard.[9] Most notes in the series are slightly out of tune and modern trumpets have slide mechanisms built in to compensate.

Types of trumpets

The most common type is the B♭ trumpet, but low F, C, D, E♭, E, G and A trumpets are also available. The C trumpet is most common in American orchestral playing, where it is used alongside the B♭ trumpet. Its slightly smaller size gives it a brighter, more lively sound. Because music written for early trumpets required the use of a different trumpet for each key — they did not have valves and therefore were not chromatic — and also because a player may choose to play a particular passage on a different trumpet from the one indicated on the written music, orchestra trumpet players are generally adept at transposing music at sight, sometimes playing music written for the B♭ trumpet on the C trumpet, and vice versa.


Piccolo trumpet in B♭, with swappable leadpipes to tune the instrument to B♭ (shorter) or A (longer)

The standard trumpet range extends from the written F♯ immediately below Middle C up to about three octaves higher. Traditional trumpet repertoire rarely calls for notes beyond this range, and the fingering tables of most method books peak at the C (*high C*) two octaves above middle C. Several trumpeters have achieved fame for their proficiency in the extreme high register, among them Maynard Ferguson, Cat Anderson, and Dizzy Gillespie. It is also possible to produce pedal tones below the low F♯, which is a device commonly employed in contemporary repertoire for the instrument.

The smallest trumpets are referred to as piccolo trumpets. The most common of these are built to play in both B♭ and A, with separate leadpipes for each key. The tubing in the B♭ piccolo trumpet is one-half the length of that in a standard B♭ trumpet. Piccolo trumpets in G, F and C are also manufactured, but are rarer. Many players use a smaller mouthpiece on the piccolo trumpet, which requires a different sound production technique from the B♭ trumpet and can limit endurance. Almost all piccolo trumpets have four valves instead of the usual three — the fourth valve lowers the pitch, usually by a fourth, to assist in the playing of lower notes and to create alternate fingerings that facilitate certain trills. Maurice André, Håkan Hardenberger, David Mason, and Wynton Marsalis are some well-known piccolo trumpet players.

Trumpets pitched in the key of low G are also called sopranos, or soprano bugles, after their adaptation from military bugles. Traditionally used in drum and bugle corps, sopranos have featured both rotary valves and piston valves.

The bass trumpet is usually played by a trombone player, being at the same pitch. Bass trumpet is played with a shallower trombone mouthpiece, and music for it is written in treble clef.

The modern slide trumpet is a B♭ trumpet that has a slide instead of valves. It is similar to a soprano trombone. The first slide trumpets emerged during the Renaissance, predating the modern trombone, and are the first attempts to increase chromaticism on the instrument. Slide trumpets were the first trumpets allowed in the Christian church.[10]


Trumpet in C with rotary valves

The historical slide trumpet was probably first developed in the late 14th century for use in alta capella wind bands. Deriving from early straight trumpets, the Renaissance slide trumpet was essentially a natural trumpet with a sliding leadpipe. This single slide was rather awkward, as the entire corpus of the instrument moved, and the range of the slide was probably no more than a major third. Originals were probably pitched in D, to fit with shawms in D and G, probably at a typical pitch standard near A=466 Hz. As no instruments from this period are known to survive, the details – and even the existence – of a Renaissance slide trumpet is a matter of some conjecture, and there continues to be some debate among scholars.[11]

Some slide trumpet designs saw use in England in the 18th century.[12]

The pocket trumpet is a compact B♭ trumpet. The bell is usually smaller than a standard trumpet and the tubing is more tightly wound to reduce the instrument size without reducing the total tube length. Its design is not standardized, and the quality of various models varies greatly. It can have a tone quality and projection unique in the trumpet world: a warm sound and a voice-like articulation. Unfortunately, since many pocket trumpet models suffer from poor design as well as cheap and sloppy manufacturing, the intonation, tone color and dynamic range of such instruments are severely hindered. Professional-standard instruments are, however, available. While they are not a substitute for the full-sized instrument, they can be useful in certain contexts. The jazz musician Don Cherry was renowned for his playing of the pocket instrument.

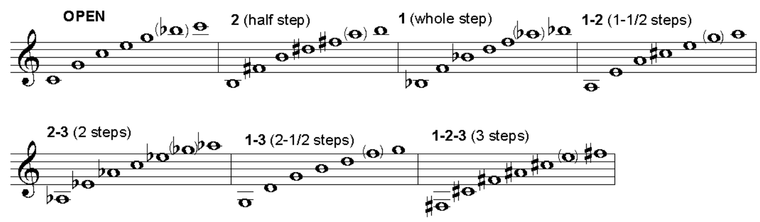
There are also rotary-valve, or German, trumpets, as well as alto and Baroque trumpets.

The trumpet is often confused with its close relative the cornet, which has a more conical tubing shape compared to the trumpet's more cylindrical tube. This, along with additional bends in the cornet's tubing, gives the cornet a slightly mellower tone, but the instruments are otherwise nearly identical. They have the same length of tubing and, therefore, the same pitch, so music written for cornet and trumpet is interchangeable. Another relative, the flugelhorn, has tubing that is even more conical than that of the cornet, and an even richer tone. It is sometimes augmented with a fourth valve to improve the intonation of some lower notes.

Playing

Fingering

On any modern trumpet, cornet, or flugelhorn, pressing the valves indicated by the numbers below will produce the written notes shown - "OPEN" means all valves up, "1" means first valve, "1-2" means first and second valve simultaneously and so on. The concert pitch which sounds depends on the transposition of the instrument. Engaging the fourth valve, if present, drops any of these pitches by a perfect fourth as well. Within each overtone series, the different pitches are attained by changing the embouchure, or lip-aperture size and "firmness". Standard fingerings above high C are the same as for the notes an octave below (C♯ is 1-2, D is 1, etc.)



A step = a tone; a half step = a semitone

Each overtone series on the trumpet begins with the first overtone - the fundamental of each overtone series can not be produced except as a pedal tone. Notes in parentheses are the sixth overtone, representing a pitch with a frequency of seven times that of the fundamental; while this pitch is close to the note shown, it is slightly flat relative to equal temperament, and use of those fingerings is generally avoided.

The fingering schema arises from the length of each valve's tubing (a longer tube produces a lower pitch). Valve "1" increases the tubing length enough to lower the pitch by one whole step, valve "2" by one half step, and valve "3" by one and a half steps. This scheme and the nature of the overtone series create the possibility of alternate fingerings for certain notes. For example, third-space "C" can be produced with no valves engaged (standard fingering) or with valves 2-3. Also, any note produced with 1-2 as its standard fingering can also be produced with valve 3 - each drops the pitch by 1-1/2 steps. Alternate fingerings may be used to improve facility in certain passages, or to aid in intonation. Extending the third valve slide when using the fingerings 1-3 or 1-2-3 further lowers the pitch slightly to improve intonation.

Extended technique

Contemporary music for the trumpet makes wide uses of extended trumpet techniques.

Flutter tonguing: The trumpeter rolls the tip of the tongue to produce a 'growling like' tone. It is achieved as if one were rolling an *R* in the Spanish language. This technique is widely employed by composers like Berio and Stockhausen.

Growling: While playing a note, clinching the back of the throat to partially obstruct the air, preventing it from flowing evenly. This creates a gargling sound, thus making a 'growling' sound from the bell. Utilized by many jazz players, not to be confused with flutter tonguing, where the tongue is 100% responsible for creating the sound desired.

Double tonguing: The player articulates using the syllables ta-ka ta-ka ta-ka

Triple tonguing: The same as double tonguing, but with the syllables ta-ta-ka ta-ta-ka ta-ta-ka.

Doodle tongue: The trumpeter tongues as if saying the word *doodle*. This is a very faint tonguing similar in sound to a valve tremolo.

Glissando: Trumpeters can slide between notes by depressing the valve halfway or changing the lip tension. Modern repertoire makes extensive use of this technique.

Vibrato: It is often regulated in contemporary repertoire through specific notation. Composers can call for everything from fast, slow or no vibrato to actual rhythmic patterns played with vibrato.

Pedal tone: Composers have written for two and a half octaves below the low F#, which is at the bottom of the standard range. Extreme low pedals are produced by slipping the lower lip out of the mouthpiece. The technique was pioneered by Bohumir Kryl.[13]

Microtones: Composers such as Scelsi and Stockhausen have made wide use of the trumpet's ability to play microtonally. Some instruments are adapted with a 4th valve which allows for a quarter-tone step between each note.

Mute belt: Karlheinz Stockhausen pioneered the use of a mute belt, worn around the player's waist, to enable rapid mute changes during pieces. The belt allows the performer to make faster and quieter mute changes, as well as enabling the performer to move around the stage.

Valve tremolo: Many notes on the trumpet can be played in several different valve combinations. By alternating between valve combinations on the same note, a tremolo effect can be created. *Berio makes extended use of this technique in his Sequenza X.*

Noises: By hissing, clicking, or breathing through the instrument, the trumpet can be made to resonate in ways that do not sound at all like a trumpet. Noises sound a 1/2 step higher than they are notated, and often require amplification to be heard.

Preparation: Composers have called for the trumpet to be played under water, or with certain slides removed. It is increasingly common for all sorts of preparations to be requested of a trumpeter. Extreme preparations involve alternate constructions, such as double bells and extra valves.

Singing: Composers such as Robert Erickson and Mark-Anthony Turnage have called for trumpeters to sing during the course of a piece, often while playing. It is possible to create a multiphonic effect by singing and playing different notes simultaneously.

Double buzz: Trumpeters can produce more than one tone simultaneously by vibrating the two lips at different speeds. The interval produced is usually an octave or a fifth.

Lip Trill or Shake: By rapidly varying lip tension, but not changing the depressed valves, the pitch varies quickly between adjacent harmonics. These are usually done, and are more straight-forward to execute, in the upper register.

Instruction and method books

One trumpet method publication of long-standing popularity is Jean-Baptiste Arban's *Complete Conservatory Method for Trumpet (Cornet)*.[14] Other well-known method books include *Technical Studies* by Herbert L. Clarke,[15] *Grand Method* by Louis Saint-Jacome,*Daily Drills and Technical Studies* by Max Schlossberg, and methods by Ernest S. Williams, Claude Gordon, Charles Colin, James Stamp and Louis Davidson.[16] Vassily Brandt's *Orchestral Etudes and Last Etudes*[17] is used in many college and conservatory trumpet studios, containing drills on permutations of standard orchestral trumpet repertoire, transpositions, and other advanced material. A common method book for beginners is the Walter Beeler's *Method for the Cornet*, and there have been several instruction books written by virtuoso Allen Vizzutti. The *Breeze Eazy* method is sometimes used to teach younger students, as it includes general musical information.

Players

Jazz trumpeter Louis Armstrong in 1953

In early jazz, Louis Armstrong was well known for his virtuosity and his improvisations on the Hot Five and Hot Seven recordings. Miles Davis is widely considered one of the most influential musicians of the 20th century. His trumpet playing was distinctive, with a vocal, clear tone that has been imitated by many. The phrasing and sense of space in his solos have been models for generations of jazz musicians.[18] Dizzy Gillespie was a gifted improviser with an extremely high range, building on the style of Roy Eldridge but adding new layers of harmonic complexity. Gillespie had an enormous impact on virtually every subsequent trumpeter, both by the example of his playing and as a mentor to younger musicians. Maynard Ferguson came to prominence playing in Stan Kenton's orchestra, before forming his own band in 1957. He was noted for being able to play accurately in a remarkably high register.[19]

Jazz trumpeter Dizzy Gillespie in 1988

Notable classical trumpeters include Maurice André, Armando Ghitalla, Alison Balsom, Hakan Hardenberger, Tine Thing Helseth, Adolph "Bud" Herseth, Malcolm McNab, Rafael Méndez, Maurice Murphy, Sergei Nakariakov, Charles Schlueter, Philip Smith, William Vacchiano, Allen Vizzutti, and Roger Voisin

Notable jazz trumpet players include Nat Adderley, Bud Brisbois, Chet Baker, Clifford Brown, Donald Byrd, Doc Cheatham, Don Cherry, Kenny Dorham, Dave Douglas, Jon Faddis, Maynard Ferguson, Roy Hargrove, Tom Harrell, Freddie Hubbard, Roger Ingram, Harry James, Wynton Marsalis, Blue Mitchell, Lee Morgan, Fats Navarro, Nicholas Payton, Claudio Roditi, Wallace Roney, Arturo Sandoval, Bobby Shew, Doc Severinsen, Woody Shaw, Allen Vizzutti, Cootie Williams, and Snooky Young.

Notable natural trumpet players include Valentine Snow for whom Handel wrote several pieces and Gottfried Reiche who was Bach's chief trumpeter.

The American orchestral trumpet sound is largely attributable to Adolph "Bud" Herseth's 53-year tenure with the Chicago Symphony Orchestra. Though he was not as prolific a teacher as some of his peers, his widely recorded sound became the standard for American orchestras.

Musical pieces

Solos

The chromatic trumpet was first made in the late 18th century. The repertoire for the natural trumpet and cornetto is extensive. This music is commonly played on modern piccolo trumpets, although there are many highly proficient performers of the original instruments. This vast body of repertoire includes the music of Gabrieli, Monteverdi, Bach, Vivaldi and countless other composers. Because the overtone series doesn't allow stepwise movement until the upper register, the tessitura for this repertoire is very high.

Joseph Haydn's Trumpet Concerto was one of the first for a chromatic trumpet,[20] a fact shown off by some stepwise melodies played low in the instrument's range. Johann Hummel wrote the other great Trumpet Concerto of the Classical period, and these two pieces are the cornerstone of the instrument's repertoire. Written as they were in the infancy of the chromatic trumpet, they reflect only a minor advancement of the trumpet's musical language, with

the Hummel's being the more adventurous piece by far.

In 1827, François Dauverné became the first musician to use the new F three-valved trumpet in public performance.

In the 20th century, trumpet repertoire expanded rapidly as composers embraced the almost completely untapped potential of the modern trumpet.

References

Notes

[1] "History of the Trumpet" (http://www.petrouska.com/historyofthetrumpet.htm). petrouska.com. . Retrieved 2008-05-03.

[2] Edward Tarr, *The Trumpet* (Portland, Oregon: Amadeus Press, 1988), 20-30.

[3] "Trumpet with a swelling decorated with a human head," *Musée du Louvre* (http://www.louvre.fr/llv/oeuvres/detail_notice.jsp?CONTENT<>cnt_id=10134198673225306&CURRENT_LLV_NOTICE<>cnt_id=10134198673225306&FOLDER<>folder_id=9852723696500803&bmUID=1164415855346&bmLocale=en)

[4] Berrin, Katherine & Larco Museum. *The Spirit of Ancient Peru:Treasures from the Museo Arqueológico Rafael Larco Herrera.* New York: Thames and Hudson, 1997.

[5] "Chicago Symphony Orchestra - Glossary - Brass instruments" (http://www.cso.org/main.taf?p=1,1,4,3). cso.org. . Retrieved 2008-05-03.

[6] Berlioz, Hector (1844). *Treatise on modern Instrumentation and Orchestration*. Edwin F. Kalmus, NY, 1948.

[7] "Trumpet, Brass Instrument" (http://www.dsokids.com/2001/dso.asp?PageID=162). dsokids.com. . Retrieved 2008-05-03.

[8] Dr. Colin Bloch (August 1978). "The Bell-Tuned Trumpet" (http://www.dallasmusic.org/schilke/Tunable Bell Trumpets.html). . Retrieved 25 February 2010.

[9] D. J. Blaikley, "How a Trumpet Is Made. I. The Natural Trumpet and Horn", *The Musical Times*, January 1, 1910, p. 15.

[10] Tarr

[11] "IngentaConnect More about Renaissance slide trumpets: fact or fiction?" (http://www.ingentaconnect.com/content/oup/earlyj/2004/00000032/00000002/art00252). ingentaconnect.com. . Retrieved 2008-05-03.

[12] "JSTOR: Notes, Second Series, Vol. 54, No. 2, (1997), pp. 484-485" (http://www.jstor.org/pss/899543). jstor.org. . Retrieved 2008-05-03.

[13] Joseph Wheeler, "Review: Edward H. Tarr, *Die Trompete*" *The Galpin Society Journal*, Vol. 31, May, 1978, p. 167.

[14] Arban, Jean-Baptiste (1894, 1936, 1982). *Arban's Complete Conservatory Method for trumpet*. Carl Fischer, Inc. ISBN 0-8258-0385-3.

[15] Herbert L. Clarke (1984). *Technical Studies for the Cornet,C. Carl Fischer, Inc. ISBN 0-8258-0158-3.*

[16] Colin, Charles and *Advanced Lip Flexibilities*.

[17] Vassily Brandt Orchestral Etudes and Last Etudes. ISBN 0-7692-9779-X.

[18] "Miles Davis, Trumpeter, Dies; Jazz Genius, 65, Defined Cool" (http://www.nytimes.com/learning/general/onthisday/bday/0525.html). nytimes.com. . Retrieved 2008-05-03.

[19] "Ferguson, Maynard" (http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=U1ARTU0001188). *Encyclopedia of Music in Canada*. The Canadian Encyclopedia. . Retrieved 2008-01-02.

[20] Keith Anderson, liner notes for Naxos CD 8.550243, *Famous Trumpet Concertos*, "Haydn's concerto, written for Weidinger in 1796, must have startled contemporary audiences by its novelty. At the first performance of the new concerto in Vienna in 1800 a trumpet melody was heard in a lower register than had hitherto been practicable."

Bibliography

- Don L. Smithers, *The Music and History of the Baroque Trumpet Before 1721*, Syracuse University Press, 1973, ISBN 0815621574
- Philip Bate, *The Trumpet and Trombone: An Outline of Their History, Development, and Construction*, Ernest Benn, 1978, ISBN 0393021297
- Roger Sherman, *Trumpeter's Handbook: A Comprehensive Guide to Playing and Teaching the Trumpet*, Accura Music, 1979, ISBN 0918194024
- Stan Skardinski, *You Can't Be Timid With a Trumpet: Notes from the Orchestra*, Lothrop, Lee & Shepard Books, 1980, ISBN 0688419631
- Robert Barclay, *The Art of the Trumpet-Maker: The Materials, Tools and Techniques of the Seventeenth and Eighteenth Centuries in Nuremberg* , Oxford University Press, 1992, ISBN 0198162235
- James Arthur Brownlow, *The Last Trumpet: A History of the English Slide Trumpet*, Pendragon Press, 1996, ISBN 0945193815

- Frank Gabriel Campos, *Trumpet Technique*, Oxford University Press, 2005, ISBN 0195166922
- Gabriele Cassone, *The Trumpet Book*, pages 352+CD, illustrated, Zecchini Editore, 2009, ISBN 8887203806

External links

- International Trumpet Guild (http://www.trumpetguild.org) international trumpet players' association with online library of scholarly journal back issues, news, jobs and other trumpet resources.
- Trumpet Playing Articles (http://www.purtle.com/jeff_articles.html) by Jeff Purtle, protege of Claude Gordon
- Jay Lichtmann's trumpet studies (http://uhaweb.hartford.edu/lichtmann/tptstudies.html) Scales and technical trumpet studies.
- Dallas Music (http://www.dallasmusic.org/gearhead) — a non-profit musical instrument resource site
- A trumpet fingering chart (http://www.lyricbrass.com/spang/fctrumpet.pdf)PDF (43.2 KiB)

Clavinet

Clavinet

Keyboard instrument	
Other names	Clav, Clavi
Classification	• Keyboard • Chordophone • Electric piano
Playing range	
F1 – E6	
Related instruments	
Cembalet, Pianet, Duo, Clavichord	
Builders	
Hohner	

A **Clavinet** is an electrophonic keyboard instrument manufactured by the Hohner company. It is essentially an electronically amplified clavichord, analogous to an electric guitar. Its distinctive bright staccato sound has appeared particularly in funk, disco, rock, and reggae songs.

Various models were produced over the years, including the models I, II, L, C, D6, and E7. Most models consist of 60 keys and 60 associated strings, giving it a five-octave range from F1 to E6.

Each key uses a small rubber tip to perform a "hammer on" (forcefully fret the string) to a guitar-type string when it is pressed, as with a conventional clavichord. The end of each string farthest from the pickups passes through a weave of yarn. When the key is released, the yarn makes the string immediately stop vibrating. This mechanism is completely different from the other Hohner keyboard products, the Cembalet and Pianet, which use the principle of plectra or sticky pads plucking metal reeds.

Most Clavinets have two sets of pickups, which are positioned above and below the strings. The Clavinet has pickup selector switches, and a guitar-level output which can be patched to a guitar amp. Early Clavinet models featured single-coil pickups; the D6 introduced a six-core pickup design.

Originally the instrument was designed for home use and aimed at playing early European classical and folk music. The Clavinet L, introduced in 1968 was a domestic model and featured a wood-veneered triangular body with wooden legs, reverse-colour keys and an acrylic glass music stand. The final E7 model saw the culmination of several engineering improvements to make the instrument more suitable for use in live amplified rock music, where its use had become commonplace. By 1982 however, the Hohner corporation had ceased production of the Clavinet. The "Clavinet DP" name was applied by Hohner to a range of Japanese-made digital pianos during the late 1980s. These instruments were designed for the home market and made no attempt to emulate any characteristics of the true Clavinet. In 2000 Hohner disassociated themselves from the Clavinet completely by unloading their spare parts inventory to restoration website Clavinet.com [1].

External links

- The Hohner Clavinet Resource Homepage [1]
- Hohner Clavinet videos, soundsamples & schematics [2]

The Clavinet C, used on Stevie Wonder's Superstition.

The Clavinet D6, the most popular model, introduced in 1971.

References

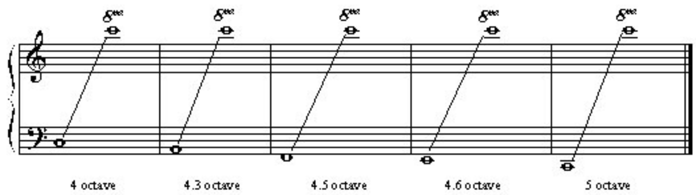
[1] http://www.clavinet.com
[2] http://www.clavinet.de/en/vids.html

Marimba

Marimba

Marimba, model Antonko AMC-12

Classification	Percussion instrument (Idiophone)
Hornbostel-Sachs classification	111.212
Playing range	



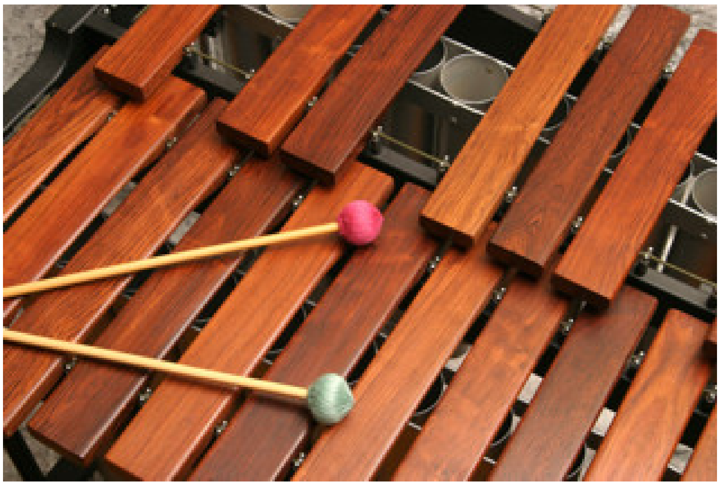
Musicians	
List of marimbists	
Builders	
List of marimba manufacturers	

The **marimba** (pronunciation) is a musical instrument in the percussion family. It consists of a set of wooden keys or bars with resonators. The bars are struck with mallets to produce musical tones. The keys are arranged as those of a piano, with the accidentals raised vertically and overlapping the natural keys (similar to a piano) to aid the performer both visually and physically. This instrument is a type of xylophone, but with broader and lower tonal range and resonators.

The chromatic marimba was developend only Guatemala[1] from the diatonic marimba, an instrument whose ancestor was a type of balafon that African slaves built in Central America.

Modern uses of the marimba include solo performances, woodwind ensembles, marimba concertos, jazz ensembles, marching band (front ensembles), drum and bugle corps, and orchestral compositions. Contemporary composers have utilized the unique sound of the marimba more and more in recent years.

Bars



Marimba bars are typically made of either wood or synthetic material, rosewood being the most desirable. Padouk is commonly used as a more affordable alternative. Bars made from synthetic materials generally fall short in sound quality in comparison to wooden bars, but are less expensive and yield added durability and weather resistance,[2] making them suitable for outdoor use; marimbas with wooden bars are usually played inside because the bars are susceptible to pitch change due to weather. Bubinga and mahogany have also been cited as comparable to rosewood in quality for use as marimba bars.[3] The specific rosewood used is universally from Honduras, *Dalbergia stevensonii*. This wood has a Janka rating of 2200, which is about three times harder than Silver Maple. The bars are wider and longer at the lowest pitched notes, and gradually get narrower and shorter as the notes get higher. During the tuning, wood is taken from the middle underside of the bar to lower the pitch. Because of this, the bars are also thinner in the lowest pitch register and thicker in the highest pitch register.

In Africa, most marimbas are made by local artisans from locally available materials.

Marimba bars produce their fullest sound when struck just off center, while striking the bar in the center produces a more articulate tone. On chromatic marimbas, the accidentals (*black keys*) can also be played on the space between the front edge of the bar and its node (the place where the string goes through the bar) if necessary. Playing on the node produces a sonically weak tone, and the technique is only used when the player or composer is looking for a muted sound from the instrument.

Range

There is no standard range of the marimba, but the most common ranges are 4 octaves, 4.3 octaves and 5 octaves; 4.5, 4.6 and 5.5 octave sizes are also available.

> 4 octave: C3 to C7.
>
> 4.3 octave: A2 to C7. The 3 refers to three notes below the 4 octave instrument. This is the most common range.
>
> 4.5 octave: F2 to C7. The .5 means "half";
>
> 4.6 octave: E2 to C7, one note below the 4.5. Useful for playing guitar literature and transcriptions.
>
> 5 octave: C2 to C7, one full octave below the 4 octave instrument, useful for playing cello trascriptions e.g. Bach's *cello suites*.

The range of the marimba has been gradually expanding, with companies like Marimba One adding notes up to F above the normal high C (C7) on their 5.5 octave instrument, or marimba tuners adding notes lower than the low C on the 5 octave C2. Adding lower notes is somewhat impractical; as the bars become bigger and the resonators become longer, the instrument must be taller and the mallets must be heavier in order to produce a tone rather than just a percussive attack. Adding higher notes is also impractical because the hardness of the mallets required to produce the characteristic tone of a marimba are much too hard to play with in almost any other, lower range on the instrument.

The marimba is a non-transposing instrument with no octave displacement, unlike the xylophone which sounds one octave higher than written and the glockenspiel which sounds two octaves higher than written.


PVC resonators

Resonators

Part of the key to the marimba's rich sound is its resonators. These are metal tubes (usually aluminium) that hang below each bar. The length varies according to the frequency that the bar produces. Vibrations from the bars resonate as they pass through the tubes, which amplify the tone in a manner very similar to the way in which the body of a guitar or cello would. In instruments exceeding 4½ octaves, the length of tubing required for the bass notes exceeds the height of the instrument. Some manufacturers, such as DeMorrow and Malletech, compensate for this by bending the ends of the tubes. This involves soldering smaller straight sections of tubes to form "curved" tubes. Both DeMorrow and Malletech use brass rather than aluminium. Others, such as Adams and Yamaha, expand the tubes into large box-shaped bottoms, resulting in the necessary amount of resonating space without having to extend the tubes. This result is achieved by the custom manufacturer Marimba One by widening the resonators into an oval shape, with the lowest ones reaching nearly a foot in width, and doubling the tube up inside the lowest resonators.

Resonator tuning involves adjusting "stops" in the tubes themselves to compensate for temperature and humidity conditions in the room where the instrument is stored. Some companies offer adjustment in the upper octaves only. Others do not have any adjustable stops. Still some companies (Malletech and DeMorrow) offer full range adjustable stops.

On many marimbas, decorative resonators are added to fill the gaps in the accidental resonator bank. In addition to this, the resonator lengths are sometimes altered to form a decorative arch, such as in the Musser M-250. This does not affect the resonant properties, because the end plugs in the resonators are still placed at their respective lengths.

Mallets

The mallet shaft is commonly made of wood, usually birch, but may also be rattan or fibreglass. The most common diameter of the shaft is around 5/16". Shafts made of rattan have a certain elasticity to them, while birch has almost no give. Professionals use both depending on their preferences, whether they are playing with two mallets or more, and which grip they use if they are using a four-mallet grip.

Appropriate mallets for the instrument depend on the range. The material at the end of the shaft is almost always a type of rubber, usually wrapped with yarn. Softer mallets are used at the lowest notes, and harder mallets are used at the highest notes. Mallets that are too hard will damage the instrument, and mallets that might be appropriate for the upper range could damage the notes in the lower range (especially on a padouk or rosewood instrument). On the lower notes, the bars are larger, and require a heavier mallet to bring out a strong fundamental. Because of the need to use different hardnesses of mallets, some players, when playing with four or more mallets, might use graduated mallets to match the bars that they are playing (softer on the left, harder on the right).

Some mallets, called "two-toned" or "multi-tonal", have a hard core, loosely wrapped with yarn. These are designed to sound articulate when playing at a loud dynamic, and broader at the quieter dynamics.

Mallet technique

Modern marimba music calls for simultaneous use of between two and four mallets (sometimes up to six), granting the performer the ability to play chords or music with large interval skips more easily. Multiple mallets are held in the same hand using any of a number of techniques or *grips*. For two mallets in each hand, the most common grips are the Burton grip (made popular by Gary Burton), the Traditional Grip (or "cross grip") and the Musser-Stevens grip (made popular by Leigh Howard Stevens). Each grip is perceived to have its own benefits and drawbacks. For example, some marimbists feel the Musser-Stevens grip is more suitable for quick interval changes, while the Burton grip is more suitable for stronger playing or switching between chords and single-note melody lines. The Traditional Grip gives a greater dynamic range and freedom of playing. The choice of grip varies by region (the Musser-Stevens grip and the Burton grip are more popular in the United States, while the traditional grip is more popular in Japan), by instrument (the Burton grip is less likely to be used on marimba than on a vibraphone) and by the preference of the individual performer.

The six-mallet grip is generally a combination of these three grips. Six mallet marimba grip has been used for years by Mexican and Central American marimbists. Keiko Abe has written a number of compositions for six mallets, including a section in her concerto *Prism Rhapsody.* Other marimbists/composers using this technique include Dean Gronemeier, Robert Paterson and Kai Stensgaard.

The traditional instrument

In the most traditional versions, various sizes of natural gourds are attached below the keys to act as resonators; in more sophisticated versions carved wooden resonators are substituted, allowing for more precise tuning of pitch. In Central America, a hole is often carved into the bottom of each resonator and then covered with thin sheep skin to add a characteristic "buzzing" or "rattling" sound known as *charleo*.[4] In more contemporary-style marimbas, wood is replaced by PVC tubing. The holes in the bottoms of the tubes are covered with a thin layer of paper to produce the buzzing noise.

"The Marimba" from "The Capitals of Spanish America" (1888)

Traditional marimba bands are especially popular in Guatemala where they are the national symbol of culture, but are also strongly established in southern Mexico, Honduras, Nicaragua and Costa Rica, as well as among Afro-Ecuadorians and Afro-Colombians.

Folk marimba with gourds, Highland Guatemala

Classical works with the marimba

A marimba player (NDR Radiophilharmonie, Hanover, 2003)

- Paul Creston: *Concertino for Marimba* (1940)
- John Harbison: *Concerto for Bass Viol* (2005)
- Hans Werner Henze: *Five Scenes from the Snow Country* for Marimba solo (1978)
- Linda Maxey: The Artistry of the Marimba (1994)
- Olivier Messiaen: *La Transfiguration de Notre Seigneur Jésus-Christ* ("The Transfiguration of Our Lord Jesus Christ"), large 10-part chorus, piano solo, cello solo, flute solo, clarinet solo, xylorimba solo, vibraphone solo, large orchestra (1965–69)
- Olivier Messiaen: *Saint-François d'Assise* (*Saint Francis of Assisi*, opera)
- Darius Milhaud: *Concerto for Marimba, Vibraphone and Orchestra*, Op. 278 (1947)
- Luigi Morleo: *Concerto per Marimba e Archi* (1993)
- Thea Musgrave: *Journey through a Japanese Landscape* (1994)
- Andrea Poggiali: *Volution* (2008)
- Carlos Rafael Rivera: *Popol-Vuh (Four Mayan Scenes for Orchestra)*, small orchestra (2005)
- Steve Reich: *Music for 18 Musicians* (1976), *Six Marimbas* (1986), *Nagoya Marimbas* (for two marimbas) (1994)
- Ney Rosauro: *Concerto For Marimba and Orchestra* (1986), Concerto No. 2 for Marimba and Orchestra (2001), numerous solo works

- Joseph Schwantner: *Velocities* (1990)
- Paul Smadbeck: *Rhythm Song* (1984)
- William Susman: *Amores Montuños* (2008) for flute & marimba, *Marimba Montuño* (2002) for solo marimba
- William Susman: *Three Different Keyboards* (2001) for accordion, marimba & piano, *Exposé* (1989) for two marimbas, two violins & piano
- Josef Tal: *Chamber Music* (1982) for Recorder, Marimba and Harpsichord
- Noah D. Taylor: *Concerto No. 1*, for Marimba and Orchestra (2003)
- Augusta Read Thomas: *Silhouettes* (2004)
- Aisha Duo: *Quiet Songs* (2005)
- Safri Duo: *Baya Baya*
- Mitchell Peters: "Yellow After the Rain"

The marimba in other music

There have been numerous jazz vibraphonists who also played the marimba. Notable among them are Gary Burton, David Friedman, Stefon Harris, Bobby Hutcherson, Joe Locke, Steve Nelson, Red Norvo, Dave Pike, Gloria Parker, Dave Samuels and Arthur Lipner.

Marimba was played famously by Brian Jones in the Rolling Stones' songs "Under My Thumb" and "Out of Time." "Island Girl" by Elton John and "Moonlight Feels Right" by Starbuck also prominently feature the instrument. Ruth Underwood played an electrically amplified marimba in Frank Zappa's Mothers of Invention. Art Tripp played the marimba on several of Captain Beefheart & the Magic Band's albums, most notably on *Lick My Decals Off, Baby* and *The Spotlight Kid*. Victor Feldman played the marimba on several of Steely Dan's early albums. It is played at the start of "Mamma Mia" by ABBA.[5] Percussionist Evelyn Glennie has collaborated with Björk and can be heard playing the marimba on *Post* and *Telegram*, as well as "Oxygen". Jack White played marimba on "The Nurse", a song on The White Stripes' album *Get Behind Me Satan*. In 2003, Marina Calzado Linage recorded an album bridging the gap between academic and popular music, *Marimba de Buenos Aires*, featuring music by Ástor Piazzolla. In 2009, Canadian musician Spencer Krug, working under the moniker 'Moonface', released a 20 minute continuous piece called *Dreamland EP: Marimba And Shit-Drums* with Jagjaguwar. The recording consists entirely of marimba, drums and vocals and comprises many movements and recurring themes.

References

[1] Helmut Brenner: *Marimbas in Lateinamerika. Historische Fakten und Status quo der Marimbatraditionen in Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Kolumbien, Ecuador und Brasilien but mainly un Guatemala (=Studien und Materialien zur Musikwissenschaft 43), Hildesheim–Zürich–New York: Georg Olms Verlag, 2007.*

[2] "Marimba Bars" (http://www.pearldrummersforum.com/showthread.php?125662-Marimba-bars&p=1850977670&viewfull=1#post1850977670). . Retrieved 16 July 2011.

[3] "Making the Bars" (http://www.craftymusicteachers.com/bassmarimba/bars.html). Crafty Music Teachers. . Retrieved 16 July 2011.

[4] Chenowith, Vida. *The Marimbas of Guatemala*., quoted in Squyres, Danielle (2002-01-02). "The Marimba, Xylophone and Orchestra Bells" (http://mmd.foxtail.com/Archives/Digests/200201/2002.01.09.04.html). Mechanical Music Digest Archives. . Retrieved 2006-12-06.

[5] "Mamma Mia – The Song That Saved ABBA" (http://www.abbasite.com/articles/articles/mamma-mia-—-the-song-that-saved-abba). *ABBA - The Official Site*. Polar Music International. . Retrieved 25 September 2009.

External links

- Science of the Marimba (http://faculty.smu.edu/ttunks/projects/merrill/MarimbaH.html)—Scientific aspects of its construction and performance
- The La Favre 5 Octave Marimba (http://www.lafavre.us/marimba.htm)—Physics and construction with images, sounds, animations and data
- Origin of Southern African marimbas, by Andrew Tracey (http://www.kalimba.co.za/old/marimbahistory.html)

Triangle (instrument)

Triangle

Classification	Hand percussion, idiophone
Playing range	
Single note, open and closed	

The **triangle** is an idiophone type of musical instrument in the percussion family. It is a bar of metal, usually steel but sometimes other metals like beryllium copper, bent into a triangle shape. The instrument is usually held by a loop of some form of thread or wire at the top curve. It was first made around the 16th century.

Shaping

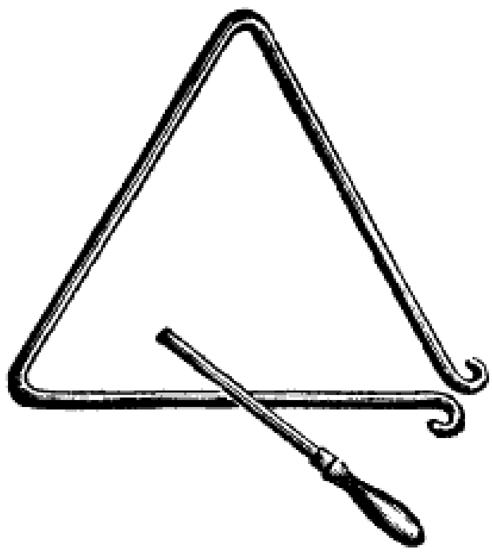
On a triangle instrument, one of the angles is left open, with the ends of the bar not quite touching. This causes the instrument to be of indeterminate or not settled or decided pitch. It is either suspended from one of the other corners by a piece of thin wire or gut, leaving it free to vibrate, or hooked over the hand. It is usually struck with a metal beater, giving a high-pitched, ringing tone.

Although the shape is today generally in the form of an equilateral triangle, early instruments were often formed as isosceles triangles. In the early days the triangles had jingling rings along the lower side.

Use and technique

In folk music, forró and rock music a triangle is more often hooked over the hand so that one side can be damped by the fingers to vary the tone. The pitch can also be modulated slightly by varying the area struck and by more subtle damping.

The triangle (known in Cajun French as a tit-fer) is popular in Cajun music where it serves as the strong beat, especially if no drums are present.[1]



An old-fashioned triangle, with wand (beater)

In European classical music, the triangle has been used in the western classical orchestra since around the middle of the 18th century. Wolfgang Amadeus Mozart, Joseph Haydn and Ludwig van Beethoven all used it, though sparingly, usually in imitation of Janissary bands. The first piece to make the triangle really prominent was Franz Liszt's Piano Concerto No. 1, where it is used as a solo instrument in the third movement, giving this

concerto the nickname of "triangle concerto". In the 19th century, the triangle was used in some music by Richard Wagner, such as the "Bridal chorus" from *"Lohengrin"* (opera). The triangle is used extensively in Hans Rott's Symphony in E major, particularly in the BIS recording, and in later recordings, the conductor has reduced its role. [2]

When ignoring pitch modulation and damping, the triangle appears to require no specialist ability to play and is often used in jokes and one liners as an archetypal instrument that requires no skill to play. The Martin Short sketch comedy character Ed Grimley is the best known example. However, triangle parts in classical music can be very demanding, and James Blades in the *Grove Dictionary of Music and Musicians* writes that "the triangle is by no means a simple instrument to play". In the hands of an expert it can be a surprisingly subtle and expressive instrument.

Most difficulties in playing the triangle come from the complex rhythms which are sometimes written for it, although it can also be quite difficult to control the level of volume. Very quiet notes can be obtained by using a much lighter beater — knitting needles are sometimes used for the quietest notes. Composers sometimes call for a wooden beater to be used instead of a metal one, which gives a rather "duller" and quieter tone. When the instrument is played with one beater, the hand that holds the triangle can also be used to damp or slightly modify the tone. For complex rapid rhythms, the instrument may be suspended from a stand and played with two beaters, although this makes it more difficult to control.

It is historically associated with calling people to dinner, especially in nineteenth century depictions.

In popular culture

Angelika Kauffmann: *L'Allegra*, 1779

A notable player of the triangle is John Deacon of the rock group Queen. He would play the triangle in live performances of Killer Queen, hanging it from his microphone. It can be heard in short breaks on the Joni Mitchell song "Big Yellow Taxi". Noted zydeco musician Alphonse "Bois Sec" Ardoin started his musical training on the triangle as a child.

The triangle also provides the trademark percussion during the opening bars of Henry Mancini's famous theme for *The Pink Panther*.

The opening theme for Blackadder Goes Forth includes Baldrick playing a single note on a triangle at the end of the song.

The percussionist with the Foo Fighters had a twenty-second triangle solo in front of 85,000 people each night when the band played Wembley Stadium on the 6th & 7 June, 2008. Other notable triangle players include English folk singer Norma Waterson and newcomer Moody Mascott from the new wave/minimalist German French pop group Kommando Trash. Kommando Trash's 52nd track 'Listen, Appreciate' features the triangle. In addition, the Israeli Progressive Metal band Solstice Coil released a parody video on the well known American Progressive Metal band Dream Theater, in which the prominent character was a triangle player known as "Triangle Guy". [3]

Notes

[1] "Louisiana Voices Glossary" (http://www.louisianavoices.org/edu_glossary.html) (Under definition for Tit-fer). . Retrieved 2008-03-08.
[2] "OUP: Richard WAGNER (1813-1883)" (instruments used), Oxford University Press, 2006, webpage: OUPcoUK-Wagner (http://www.oup.co.uk/hirecat/Wagner/).
[3] "The Natural Causes Carries On", Solstice Coil, 2011 (http://www.youtube.com/watch?v=hEMA3Ptoo5Q).

Zill

Zills, also **zils** or **finger cymbals**, (from Turkish *zil*, "cymbals" [1]) are tiny metallic cymbals used in belly dancing and similar performances.[2] They are called ***sājāt*** (صاجات) in Arabic. They are similar to Tibetan tingsha bells.

A pair of zills from the Khan el-Khalili market in Cairo

Features

A set of zills consists of four cymbals, two for each hand. Modern zills come in a range of sizes, the most common having a diameter of about 5 cm (2 in). Different sizes and shapes of zills will produce sounds that differ in volume, tone and resonance. For instance, a dancer performing with an orchestra will use a larger zill with more volume, whereas a cabaret dancer will use a zill with a more delicate sound. American Tribal dancers typically use a much larger zill with a more mellow tone.

Makers of zills commonly use brass rather than the bronze used for larger cymbals, but they may also employ many other alloys. They may plate some zills in order to give a silvery colour or a brighter surface. Performance zills vary in appearance and may be shiny, dull, plain or engraved.

Modern dancers use elastic to secure the zills, one to the thumb and one to the middle finger of each hand. Professional zills have two slots to allow the threading of the elastic through the zill, whereas cheaper versions (including tourist versions) have only one hole.

Zills can be played in several ways, to produce either ringing tones or a harsh "clack" sound.

Zills belong to the standard instruments used in Ottoman military bands and also occasionally appear as part of Western orchestral or other musical performances. In these cases musicians usually just call them *finger cymbals* and use them to obtain a ringing sound with "Middle Eastern" associations. Percussionists playing finger cymbals sometimes use a less complicated technique than the traditional one used by dancers. The musician holds one cymbal in each hand by gripping the strap between the thumb and the index finger, and plays them by striking the rims together. They use this technique for occasional flourishes in the music rather than for complex rhythms and sounds.

There are many rhythms in belly dancing music that can be spelled out in finger cymbal playing:[3]

- triplets (left/right/left/pause – “giddyup, giddyup, giddyup”)
- quads (L/R/L/R/no pause)
- beledi (dum/dum/tek-a-tek/dum-tek-a-tek)
- chiftatelli (dum/dum/tek-a-tek/dum/dum/dum – “John went to the sea; caught. three. fish.”)
- ayub (dum/a-tek-tek – “buy more shoes, and…buy more shoes, and . . .,”)

- bolero (dum/tek-a-tek-tek/dum/dum/dum/dum – “I want to be a belly dancer”)

Notes

[1] The American Heritage Dictionary of the English Language
[2] Dictionary.com - *definition of zill* (http://dictionary.reference.com/browse/zill)
[3] Cymbal Symbolism http://bellydancingdiva.com/2009/09/cymbal-symbolism/

References

- Foreman, Kelly Marie. "Zills, the Idiophone of the Middle Eastern Belly Dancer: Their History, Pedagogy, Techniques of Playing, and Role in the Context of Bodily Expression" (1994). M.A. thesis. Kent, Ohio: Kent State University.

External links

- (http://dwp.bigplanet.com/saroyan/onlinestore/) Saroyan zills has mp3 sound samples of their zills

Bass guitar

Bass guitar

A Music Man Stingray bass

String instrument	
Other names	Bass, electric bass guitar, electric bass
Classification	String instrument (plucked or picked; rarely strummed)
Hornbostel-Sachs classification	321.322 (Composite chordophone)
Inventor(s)	Paul Tutmarc, Leo Fender
Developed	1930s

Playing range

(a standard tuned 4-string bass guitar)

Related instruments

- Electric guitar
- Double bass
- Acoustic bass guitar

Musicians

- List of bass guitarists

The **bass guitar**[1] (also called **electric bass**,[2] [3] [4] or simply **bass**; /ˈbeɪs/) is a stringed instrument played primarily with the fingers or thumb (by plucking, slapping, popping, tapping, or thumping), or by using a pick.

The bass guitar is similar in appearance and construction to an electric guitar, but with a longer neck and scale length, and four, five, or six strings. The four-string bass—by far the most common—is usually tuned the same as the double bass,[5] which corresponds to pitches one octave lower than the four lower strings of a guitar (E, A, D, and G).[6] The bass guitar is a transposing instrument, as it is notated in bass clef an octave higher than it sounds (as is the double bass) to avoid excessive ledger lines. Like the electric guitar, the bass guitar is plugged into an amplifier and speaker for live performances.

Since the 1950s, the bass guitar has largely replaced the double bass in popular music as the bass instrument in the rhythm section. While the types of basslines performed by the bassist vary widely from one style of music to another, the bassist fulfills a similar role in most types of music: anchoring the harmonic framework and laying down the beat. The bass guitar is used in many styles of music including rock, metal, pop, punk rock, country, blues, and jazz. It is used as a soloing instrument in jazz, fusion, Latin, funk, and in some rock and metal styles.

History

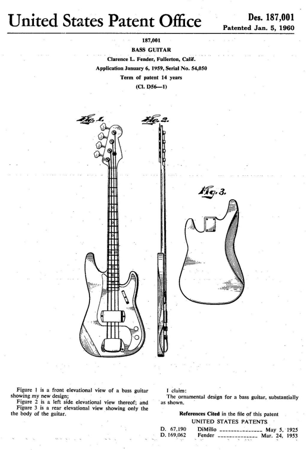
1930s–1940s

In the 1930s, musician and inventor Paul Tutmarc from Seattle, Washington, developed the first electric string bass in its modern form, a fretted instrument designed to be held and played horizontally. The 1935 sales catalog for Tutmarc's electronic musical instrument company, Audiovox, featured his "Model 736 Bass Fiddle," a four-stringed, solid-bodied, fretted electric bass instrument with a 30½-inch scale length.[7] The change to a "guitar" form made the instrument easier to hold and transport, and the addition of frets enabled bassists to play in tune more easily. Around 100 of these instruments were made during this period.

Around 1947, Tutmarc's son, Bud, began marketing a similar bass under the Serenader brand name, prominently advertised in the nationally distributed L.D. Heater Co. wholesale jobber catalogue of '48. However, the Tutmarc family inventions did not achieve market success.

Musical instrument inventor Paul Tutmarc outside his music store in Seattle, Washington

1950s



Design patent issued to Leo Fender for the second-generation Precision Bass

In the 1950s, Leo Fender, with the help of his employee George Fullerton, developed the first mass-produced electric bass.[8] His Fender Precision Bass, introduced in 1951, became a widely copied industry standard. The Precision Bass (or "P-bass") evolved from a simple, uncontoured "slab" body design similar to that of a Telecaster with a single coil pickup, to a contoured body design with beveled edges for comfort and a single four-pole "single coil pickup." This "split pickup", introduced in 1957, appears to have been two mandolin pickups (Fender was marketing a four string solid body electric mandolin at the time). Because the pole pieces of the coils were reversed with respect to each other, and the leads were also reversed with respect to each other, the two coils, wired in series, produced a humbucking effect (the same effect is achieved if the coils are wired in parallel).

The "Fender Bass was a revolutionary new instrument, one that could easily be played by an electric guitarist, could be easily transported to a gig, and could be amplified to just about any volume without feeding back"[9] Monk Montgomery was the first bass player to tour with the Fender bass guitar, with Lionel Hampton's postwar big band.[10] Roy Johnson, who replaced Montgomery in Hampton's band, and Shifty Henry with Louis Jordan & His Tympany Five, were other early Fender Bass pioneers.[8] Bill Black, playing with Elvis Presley, adopted the Fender Precision Bass around 1957.[11]


A Fender Standard Jazz Bass (front and back views)

Following Fender's lead, Gibson released the violin-shaped Electric Bass with extendable end pin in 1953, allowing it to be played upright or horizontally. Gibson renamed the Electric Bass in 1958 as the EB-1 [12] (The EB-1 was reissued around 1970, but this time without the end pin.) Also in 1958 Gibson released the maple arched top EB-2 described in the Gibson catalogue as *A hollow-body electric bass that features a Bass/Baritone pushbutton for two different tonal characteristics*.[13] In 1959 these were followed by the more conventional-looking EB-0 Bass. The EB-0 was very similar to a Gibson SG in appearance (although the earliest examples have a slab-sided body shape closer to that of the double-cutaway Les Paul Special).


Gibson EB-3

Whereas Fender basses had pickups mounted in positions in between the base of the neck and the top of the bridge, many of Gibson's early basses featured one humbucking pickup mounted directly against the neck pocket. The EB-3, introduced in 1961, also had a "mini-humbucker" at the bridge position. Gibson basses also tended to be smaller, sleeker instruments; Gibson did not produce a 34" scale bass until 1963 with the release of the Thunderbird, which was also the first Gibson bass to use dual-humbucking pickups in a more traditional position, about halfway between the neck and bridge. A small number of other companies also began manufacturing bass guitars during the 1950s: Kay in 1952, and Danelectro in 1956;[11]

1956 saw the appearance at the German trade fair "Musikmesse Frankfurt" of the distinctive Höfner 500/1 violin bass made using violin construction techniques by Walter Höfner, a second generation violin luthier.[14] The instrument is often known as the "Beatle Bass", due to its endorsement by Paul McCartney.

In 1957 Rickenbacker introduced the model 4000 bass,[15] the first bass to feature a neck-through-body design; the Fender and Gibson versions used bolt-on and glued-on necks.

1960s

With the explosion of the popularity of rock music in the 1960s, many more manufacturers began making electric basses.

First introduced in 1960, the Fender Jazz Bass was known as the Deluxe Bass and was meant to accompany the Jazzmaster guitar. The Jazz Bass (often referred to as a "J-bass") featured two single-coil pickups, one close to the bridge and one in the Precision bass' split coil pickup position. The earliest production basses had a 'stacked' volume and tone control for each pickup. This was soon changed to the familiar configuration of a volume control for each pickup, and a single, passive tone control. The Jazz Bass' neck was narrower at the nut than the Precision bass (1½" versus 1¾").

Another visual difference that set the Jazz Bass apart from the Precision is its "offset-waist" body. Pickup shapes on electric basses are often referred to as "P" or "J" pickups in reference to the visual and electrical differences between the Precision Bass and Jazz Bass pickups. Significantly, Fender chose to label the headstock of this model with a decal noting Jazz Bass Electric Bass [16].

1970s Fender Jazz Bass with maple fretboard

Fender also began production of the Mustang Bass; a 30" scale length instrument used by bassists such as Tina Weymouth of Talking Heads and Bill Wyman of The Rolling Stones ("P" and "J" basses have a scale length of 34", a design echoed on most current production electric basses of all makes). In the 1950s and 1960s, the instrument was often called the "Fender bass", due to Fender's early dominance in the market.

Gibson introduced the short-scale (30.5") bass the Gibson EB-3 in 1961, favoured by Jack Bruce of Cream.

1970s

A Rickenbacker 4001 bass.

The 1970s saw the founding of Music Man Instruments by Tom Walker, Forrest White and Leo Fender, which produced the StingRay, the first widely produced bass with active (powered) electronics. This amounts to an impedance buffering pre-amplifier on-board the instrument to lower the output impedance of the bass's pickup circuit, increasing low-end output, and overall frequency response (more lows and highs). Specific models became identified with particular styles of music, such as the Rickenbacker 4001 series, which became identified with progressive rock bassists like Chris Squire of Yes, while the StingRay was used by Louis Johnson of the funk band The Brothers Johnson.

In 1971, Alembic established the template for what became known as "boutique" or "high end" electric bass guitars. These expensive, custom-tailored instruments, as used by Phil Lesh, Jack Casady, and Stanley Clarke, featured unique designs, premium hand-finished wood bodies, onboard electronics for preamplification and equalization, and innovative construction techniques such as multi-laminate neck-through-body construction and graphite necks. In the mid-1970s, Alembic and other boutique bass manufacturers, such as Tobias, produced four-string and five-string basses with a low "B" string. In 1975, bassist Anthony Jackson commissioned luthier Carl Thompson to a six-string bass tuned (low to high) B0, E1, A1, D2, G2, C3.

1980s–2000s

An early 1980s-era Steinberger headless bass

In the 1980s, bass designers continued to explore new approaches. Ned Steinberger introduced a headless bass in 1979 and continued his innovations in the 1980s, using graphite and other new materials and (in 1984) introducing the TransTrem tremolo bar. In 1987, the Guild Guitar Corporation launched the fretless Ashbory bass, which used silicone rubber strings and a piezoelectric pickup to achieve a "double bass" sound with a short 18" scale length. In the late 1980s, MTV's "Unplugged" show, which featured bands performing with acoustic instruments, helped to popularize hollow-bodied acoustic bass guitars amplified with pickups.

During the 1990s, as five-string basses became more widely available and more affordable, an increasing number of bassists in genres ranging from metal to gospel began using five-string instruments for added lower range—a low "B" below the standard "E" string. Some bass players who performed a lot in a solo setting used five-string basses to get a higher range by adding a high "C" string as the fifth string (this is known as "tenor tuning"). As well, the onboard battery-powered electronics such as preamplifiers and equalizer circuits, which were previously only available on expensive "boutique" instruments, became increasingly available on modestly priced basses.

In the first decade of the 21st century, some bass manufacturers included digital modelling circuits inside the instrument to recreate tones and sounds from many models of basses (e.g., Line 6's Variax bass). Traditional bass designs such as the Fender Precision Bass and Fender Jazz Bass remained popular in the first decade of the 21st century; in 2006, a 60th Anniversary P-bass was introduced by Fender, along with the introduction of the Fender Jaguar Bass.

Design considerations

Bass bodies are typically made of wood, although other materials such as graphite (for example, some of the Steinberger designs) have also been used. While a wide variety of woods are suitable for use in the body, neck, and fretboard of the bass guitar, the most common type of wood used for the body is alder, for the neck is maple, and for the fretboard is rosewood. Other commonly used woods include mahogany, maple, ash, and poplar for bodies, mahogany for necks, and maple and ebony for fretboards.

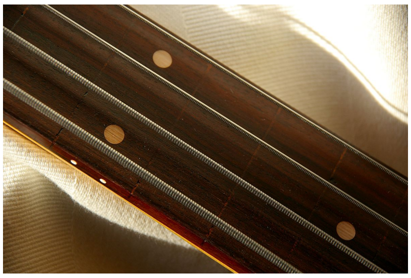
Other design options include finishes, such as lacquer, wax and oil; flat and carved designs; Luthier-produced custom-designed instruments; headless basses, which have tuning machines in the bridge of the instrument (e.g., Steinberger and Hohner designs) and several artificial materials such as luthite. The use of artificial materials (e.g., BassLab) allows for unique production techniques such as die-casting, to produce complex body shapes. While most basses have solid bodies, they can also include hollow chambers to increase the resonance or reduce the weight of the instrument. Some basses are built with entirely hollow bodies, which change the tone and resonance of the instrument. Acoustic bass guitars are typically equipped with piezoelectric or magnetic pickups and amplified.

Instruments handmade by highly skilled luthiers are becoming increasingly available. Exotic materials include woods such as bubinga, wenge, ovangkol, ebony and goncalo alves. Graphite composite is used to make lightweight necks[17] [18] Exotic woods are used on more expensive instruments: for example, Alembic uses cocobolo as a body or top layer material because of its attractive grain. Warwick bass guitars are also well-known for exotic hardwoods: most of the necks are made of ovangkol, and the fingerboards wenge or ebony. Solid bubinga bodies are also used for tonal and aesthetic qualities.

The "long scale" necks used on Leo Fender's basses, giving a scale length (distance between nut and bridge) of 34", remain the standard for electric basses. However, 30" or "short scale" instruments, such as the Höfner 500/1 "violin bass" played by Paul McCartney, and the Fender Mustang Bass are popular, especially for players with smaller hands. While 35", 35.5" and 36" scale lengths were once only available in "boutique" instruments, in the first decade of the 21st century, many manufacturers have begun offering these lengths, also called an "extra long scale." This extra long scale provides a higher string tension, which yields a more defined tone on the low "B" string of five- and six-stringed instruments (or detuned four-string basses).

Fretted and fretless basses

Another design consideration for the bass is whether to use frets on the fingerboard. On a fretted bass, the frets divide the fingerboard into semitone divisions (as on a guitar). The original Fender basses had 20 frets, but modern basses may have 24 or more. Fretless basses have a distinct sound, because the absence of frets means that the string must be pressed down directly onto the wood of the fingerboard as with the double bass. The string buzzes against the wood and is somewhat muted because the sounding portion of the string is in direct contact with the flesh of the player's finger. The fretless bass allows players to use the expressive devices of glissando, vibrato and microtonal intonations such as quarter tones and just intonation.



A fretless bass with flatwound strings; note the markers inlaid into the side of the fingerboard, to aid the performer in finding the correct pitch.

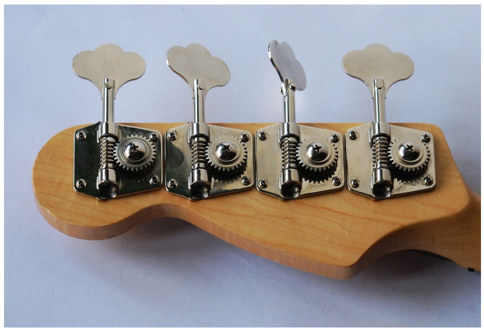
Pastorius, Convocation Hall, Toronto Nov. 27, 1977 Photo: Jean-Luc Ourlin

Some bassists use both fretted and fretless basses in performances, according to the type of material they are performing, as with Pino Palladino, whose performance on the fretless bass during the 1980s made him a highly desirable session player backing high profile musicians that included Eric Clapton and David Gilmour. However, the late 1990s showed a shift toward fretted basses as well, as he branched out into a wide variety of genres. While fretless basses are often associated with jazz and jazz fusion, bassists from other genres use fretless basses, such as metal bassist Steve DiGiorgio and Colin Edwin of modern/progressive rock band Porcupine Tree.

The first fretless bass guitar was made by Bill Wyman in 1961 when he converted an inexpensive Japanese fretted bass by removing the frets.[19] [20] The first production fretless bass was the Ampeg AUB-1 introduced in 1966, and Fender introduced a fretless Precision Bass in 1970. In the early 1970s, fusion-jazz bassist Jaco Pastorius created his own fretless bass by removing the frets[21] from a Fender Jazz Bass, filling the holes with wood putty, and coating the fretboard with epoxy resin.[22] Some fretless basses have "fret line" markers inlaid in the fingerboard as a guide, while others only use guide marks on the side of the neck.

Tapewound (double bass type) and flatwound strings are sometimes used with the fretless bass so the metal string windings do not wear down the fingerboard. Some fretless basses have epoxy coated fingerboards to increase the fingerboard' durability, enhance sustain, and give a brighter tone. Although most fretless basses have four strings, five-string and six-string fretless basses are also available. Fretless basses with more than six strings are also available as "boutique" or custom-made instruments.

Strings and tuning



The tuning machines are mounted on the back of the headstock on the bass guitar neck; note the spiral metal worm gears.

The standard design for the electric bass guitar has four strings, tuned E, A, D and G, in fourths such that the open highest string, G, is an eleventh (an octave and a fourth) below middle C, making the tuning of all four strings the same as that of the double bass. This tuning is also the same as the standard tuning on the lower four strings on a six-string guitar, only an octave lower. String types include all-metal strings (roundwound, flatwound, halfwound, ground wound, and pressure wound); as well as metal strings with different coverings, such as tapewound and plastic-coatings. The variety of materials used in the strings gives bass players a range of tonal options. In the 1950s and early 1960s, bassists mostly used flatwound strings with a smooth surface, which had a smooth, damped sound reminiscent of a double bass. In the late 1960s and 1970s, roundwound bass strings similar to guitar strings became popular, though flatwounds also continue to be popular. Roundwounds have a brighter timbre with greater sustain than flatwounds.

A number of other tuning options and bass types have been used to extend the range of the instrument. The most common are four, five, or six strings:

Washburn XB600, a six string bass

- **Four strings** with alternative tunings to obtain an extended lower range.[23] Tuning in fifths e.g., CGDA gives an extended upper and lower range.

G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G
D	D#	E	F	F#	G	G#	A	A#	B	C	C#	D
A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A
E	F	F#	G	G#	A	A#	B	C	C#	D	D#	E
					●		●		●			●●

Note positions on a right-handed four-string bass in standard EADG tuning. The dots below the frets are often inlaid into the wood of bass necks, as a visual aid to help the player find different positions.

- **Five strings** usually tuned B0-E1-A1-D2-G2, which provides extended lower range. Five string basses tuned to B-E-A-D-G (and sometimes A-D-G-C-F) are often used in contemporary rock and metal alongside seven string guitars, baritone guitars, and otherwise downtuned instruments. Another common tuning used on early five-string basses is E-A-D-G-C, known as "tenor tuning". This is still a popular tuning for jazz and solo bass. Other tunings such as C-E-A-D-G are used though rare. The fifth string provides a greater lower range (if a low B or A is used) or a greater upper range (if a high C string is added) than the four-string bass, and gives access to more notes for any given hand position. The earliest five string was created

by Fender in 1965. The Fender Bass V had the E-A-D-G-C tuning, but was unpopular and discontinued in 1970. The common low B five string was created by Jimmy Johnson as a custom instrument in 1975. He bought a EADGC 5-string Alembic bass, replaced the nut, and used a new, thick low B string from GHS to accommodate the instrument accordingly. Steinberger made a 5-string headless instrument called the L-2/5 in 1982, and later Yamaha offered the first production model as the BB5000 in 1984.

- **Six strings** are usually tuned B0-E1-A1-D2-G2-C3—like a four-string bass with an additional low "B" string and a high "C" string. Some players prefer B0-E1-A1-D2-F♯2-B3, which preserves the intervals of standard guitar tuning and makes the highest and lowest string the same note two octaves apart. While less common than four or five-string basses, they appear in Latin, jazz, and other genres, as well as in studio work where a single instrument must be highly versatile. Alternative tunings for six-string bass include B-E-A-D-G-B, matching the first five strings of an acoustic or electric guitar, and EADGBE, completely matching the tuning of a six-string guitar but one octave lower allowing the use of guitar chord fingerings. Rarer tunings such as EADGCF and F#BEADG provide a lower or higher range in a given position while maintaining consistent string intervals. The original six-string bass was the LongHorn6, created by Danelectro in 1958, as a guitar tuned down an octave (EADGBE). In 1974, Anthony Jackson worked with Carl Thompson to create the Contrabass guitar (BEADGC). Later, Jackson brought his ideas to Fodera in cooperation with Ken Smith to create a wider-spaced Contrabass guitar, which evolved to the modern six-string bass.
- **Detuners,** such as the Hipshot, are mechanical devices operated by the thumb on the fretting hand that allow one or more strings to be quickly detuned to a pre-set lower pitch. Hipshots are typically used to drop the "E"-string down to "D" on a four string bass.[24]

Alternative range approaches

A seven-string fretless bass

Some bassists have used other types of tuning methods to obtain an extended range or other benefits such as providing multiple octaves of notes at any given position, as well as a significantly larger tonal range. Instrument types or tunings used for this purpose include **basses with fewer than four strings** (one-string bass guitars,[25] two-string bass guitars, three-string bass guitars [tuned to E-A-D])[26] **alternative tunings** (e.g., tenor bass,[27] piccolo bass,[28] and guitar-tuned basses)[29] and **8, 10, 12 and 15-string** basses, which are built on the same principle as the 12-string guitar, where the strings are grouped into "courses" tuned in unison or octaves, to be played simultaneously.[30]

Extended Range Basses (ERBs) are basses with six to twelve strings—with the additional strings used for range rather than unison or octave pairs. A seven-string bass (B0-E1-A1-D2-G2-C3-F3) was built by luthier Michael Tobias in 1987. This instrument, commissioned by bassist Garry Goodman, was an early example of a bass with more than six single course strings. Conklin builds eight- and nine-string basses.[31] The Guitarbass is a ten-string instrument with four bass strings (tuned E-A-D-G) and six guitar strings (tuned E-A-D-G-B-E).[32]

Luthier Michael Adler built the first 11-string bass in 2004 and completed the first single-course 12-string bass in 2005. Adler's 11- and 12-string instruments have the same range as a grand piano.[33] Sub-contra basses, such as C#-F#-B-E ("C#" being at 17.32 Hz (C♯0))[34] have been created. Ibanez had released SR7VIISC in 2009, featuring a 30" scale and narrower width, and tuned as B-E-A-D-G-C-E; the company dubbed it a cross between bass and guitar.[35] Yves Carbonne developed 10 and 12 string fretless sub-bass guitars.[36] [37] [38]

Pickups and amplification

For more information on pickups, see Pick up (music technology).

Magnetic pickups

Most electric bass guitars use magnetic pickups. The vibrations of the instrument's metal strings within the magnetic field of the permanent magnets in magnetic pickups produce small variations in the magnetic flux threading the coils of the pickups. This in turn produces small electrical voltages in the coils. These low-level signals are then amplified and played through a speaker. Since the 1980s, basses are often available with battery-powered "active" electronics that boost the signal, provide equalization controls to boost or cut bass and treble frequencies, or both.


Dual "J"-style pickups

- **"Jazz" pickups** (referring to the original Fender Jazz Bass), also referred to as "J pickups", are wider eight-pole pickups that lie underneath all four strings. J pickups are typically single-coil designs, although there are a large number of humbucking designs. As with the halves of the P-pickups, the J-pickups are reverse-wound with reverse magnetic polarity. As a result they have hum canceling properties when used at the same volume, with hum cancellation decreasing when the pickups are used at unequal volume and altogether absent when each pickup is used individually. 'J' Style pickups tend to have a lower output and a thinner sound than 'P' Style pickups making it perfect for most rock music. Many bassists choose to combine a 'J' pickup at the bridge and a 'P' pickup at the neck, to be 'blended' together for a unique sound.
- **"Precision" pickups** (which refers to the original Fender Precision Bass), which are also referred to as "P pickups", are actually two distinct single-coil pickups. Each is offset a small amount along the length of the body so that each half is underneath two strings. The pickups are reverse-wound with reversed magnetic polarity to reduce hum. This makes the 'P' pickup a [humbucking] single coil pickup, something almost unique to the 'P' style pickup. Less common is the single-coil "P" pickup, used on the original 1951 Fender Precision bass.[39]
- **"Dual Coil" (Humbucker) pickups**, also known as "DC pickups", have two signal producing coils that are reverse wound around opposed polarity magnets (similar in principle to the two individual J-pickups). This significantly reduces noise from interference compared to single coil pickups. Humbuckers also often produce a higher output level than single coil pickups. Dual coil pickups come in two main varieties; ceramic or ceramic and steel. Ceramic only magnets have a relatively harsher sound than their ceramic and steel counterparts, and are thus used more commonly in heavier rock styles.
  - A well-known bass humbucker is the pickup used on the Music Man series of basses; it has two coils, each with four large polepieces. This style is known as the "MM" pickup for this reason, and many aftermarket pickup manufacturers and custom builders incorporate these pickups. The most common configurations are a single pickup at the bridge, two pickups similar in placement to a Jazz Bass, or an MM pickup at the bridge with a single-coil pickup (often a "J") at the neck. These pickups can often be "tapped", meaning one of the two coils can be essentially turned off, giving a sound similar to a single-coil pickup.
- **"Soapbar" Pickups** are so-named due to their resemblance to a bar of soap and originally referred to the Gibson P-90 guitar pickup. The term is also used to describe any pickup with a rectangular shape and no visible pole pieces; most of the pickups falling into this category are humbucking. They are commonly found in basses designed for the rock and metal genres, such as Gibson, ESP Guitars, and Schecter. 'Soapbar pickups' are also called 'extended housing'.

Many basses have just one pickup, typically a "P" or soapbar pickup. Multiple pickups are also quite common, two of the most common configurations being a "P" near the neck and a "J" near the bridge (e.g., Fender Precision Bass Special, Fender Precision Bass Plus), or two "J" pickups (e.g., Fender Jazz). A two-"soapbar" configuration is also very common, especially on basses by makes such as Ibanez and Yamaha. A combination of a J or other single-coil pickup at the neck and a Music Man-style humbucker in the bridge has become popular among boutique builders, giving a very bright, focused tone that is good for jazz and thumbstyle.

Some basses use more unusual pickup configurations, such as a soapbar and a "P" pickup (found on some Fenders), Stu Hamm's "Urge" basses, which have a "P" pickup sandwiched between two "J" pickups, and some of Bootsy Collins' custom basses, which had as many as 5 J pickups. Another unusual pickup configuration is found on some of the custom basses that Billy Sheehan uses, in which there is one humbucker at the neck and a split-coil pickup at the middle position.

The placement of the pickup greatly affects the sound. A pickup near the neck joint emphasizes the fundamental and low-order harmonics and thus produces a deeper, bassier sound, while a pickup near the bridge emphasizes higher-order harmonics and makes a "tighter" or "sharper" sound. Usually basses with multiple pickups allow blending of the output from the pickups, with electrical and acoustical interactions between the two pickups (such as partial phase cancellations) allowing a range of tonal effects.

Non-magnetic pickups

The use of non-magnetic pickups allows bassists to use non-ferrous strings such as nylon, brass or even silicone rubber, which create different tones.

- Piezoelectric pickups (also called "piezo" pickups) are non-magnetic pickups that use a transducer to convert vibrations in the instrument's body or bridge into an electrical signal. They are typically mounted under the bridge saddle or near the bridge and produce a different tone from magnetic pickups, often similar to that of an acoustic bass. Piezo pickups are often used in acoustic bass guitars.
- Optical pickups are another type of non-magnetic pickup. They use an infrared LED to optically track the movement of the string, which allows them to reproduce low-frequency tones at high volumes without the "hum" or excessive resonance associated with conventional magnetic pickups. Since optical pickups do not pick up high frequencies or percussive sounds well, they are commonly paired with piezoelectric pickups to fill in the missing frequencies. LightWave Systems builds basses with optical pickups.

Amplification and effects

This amplification setup is a "bass stack" approach, in which an amplifier (in this case a Hartke 5000) is plugged into separate speaker cabinets.

Like the electric guitar, the electric bass guitar is often connected to an amplifier and a speaker with a patch cord for live performances. Electric bassists use either a "combo" amplifier, which combines an amplifier and a speaker in a single cabinet, or an amplifier and a separate speaker cabinet (or cabinets). In some cases when the bass is being used with large-scale PA amplification, it is plugged into a "DI" or "direct box", which routes their signal directly into a mixing console, and thence to the main and monitor speakers. Recording may use a microphone setup for the amplified signal, a direct box feeding the recording console or a mix of both.

Various electronic bass effects such as preamplifiers, "stomp box"-style pedals and signal processors and the configuration of the amplifier and speaker can be used to alter the basic sound of the instrument. In the 1990s and early first decade of the 21st century, signal processors such as equalizers, overdrive devices, and compressors or limiters became increasingly popular. Modulation effects like chorus, flanging, phase shifting, and time effects such as delay and looping are less commonly used with bass than with electric guitar, but they are used in some styles of music.

Playing techniques

Sitting or standing

Most bass players stand while playing, although sitting is also accepted, particularly in large ensemble settings, such as jazz big bands or in acoustic genres such as folk music. Some bassists, such as Jah Wobble, will alternate between standing or seated playing. It is a matter of the player's preference as to which position gives the greatest ease of playing and what a bandleader expects. When sitting, right-handed players can balance the instrument on the right thigh or like classical guitar players, the left. Balancing the bass on the left thigh usually positions it in such a way that it mimics the standing position, allowing for less difference between the standing and sitting positions. Balancing the bass on the right thigh provides better access to the neck and fretboard in its entirety, especially lower frets.

Performing techniques

Bassist Victor Wooten performs in a bass trio called SMV with Stanley Clarke and Marcus Miller.

In contrast to the upright bass (or double bass), the electric bass guitar is played horizontally across the body, like an electric guitar. When the strings are plucked with the fingers (pizzicato), the index and middle fingers (and sometimes with the thumb, ring, and pinky fingers as well) are used. James Jamerson, an influential bassist from the Motown era, played intricate bass lines using only his index finger, which he called "The Hook." There are also variations in how a bassist chooses to rest the right-hand thumb (or left thumb in the case of left-handed players). A player may rest his or her thumb on the top edge of one of the pickups or on the side of

the fretboard, which is especially common among bassists who have an upright bass influence. Some bassists anchor their thumbs on the lowest string and move it off to play on the low string. Alternatively, the thumb can be rested loosely on the strings to mute the unused strings.


Bassist Jah Wobble frequently plays while seated

The string can be plucked at any point between the bridge and the point where the fretting hand is holding down the string; different timbres are produced depending on where along the string it is plucked. Some players are known for plucking near the bridge where the string is most taut, such as jazz fusion bassist Jaco Pastorius, whereas other bassists prefer the "looser" part of the string nearer to the fingerboard.

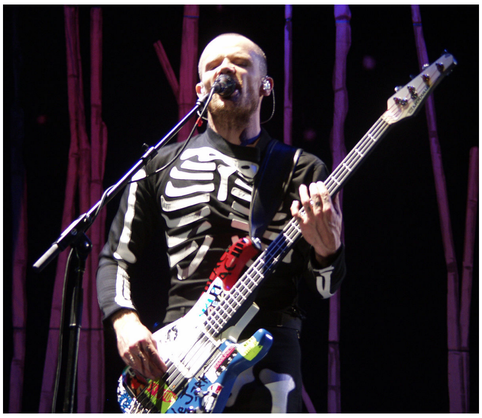
Bassists trying to emulate the sound of a double bass sometimes pluck the strings with their thumb and use palm-muting to create a short, "thumpy" tone. The late Monk Montgomery (who played in Lionel Hampton's band) and Bruce Palmer (who performed with Buffalo Springfield) use thumb downstrokes. The use of the thumb was acknowledged by early Fender models, which came with a "thumbrest" or "Tug Bar" attached to the pickguard below the strings. Contrary to its name, this was not used to rest the thumb, but to provide leverage while using the thumb to pluck the strings. The thumbrest was moved above the strings in 1970s models and eliminated in the 1980s.

"Slap and pop"

The slap and pop method, or "thumbstyle", most associated with funk, uses tones and percussive sounds achieved by striking, thumping, or "slapping" a string with the thumb and snapping (or "popping") a string or strings with the index or middle fingers. Bassists often interpolate left hand-muted "dead notes" between the slaps and pops to achieve a rapid percussive effect, and after a note is slapped or popped, the fretting hand may cause other notes to sound by using "hammer ons", "pull offs", or a left-hand glissando (slide). Larry Graham of Sly and the Family Stone and Graham Central Station was an early innovator of the slap style, and Louis Johnson of The Brothers Johnson is also credited as an early slap bass player.

Slap and pop style is also used by many bassists in other genres, such as rock (e.g., J J Burnel and Les Claypool), metal (e.g., Eric Langlois, Martin Mendez, Fieldy and Ryan Martinie), and fusion (e.g., Marcus Miller, Victor Wooten and Alain Caron). Slap style playing was popularized throughout the 1980s and early 1990s by pop bass players such as Mark King (from Level 42) and rock bassists such as with Pino Palladino (currently a member of the John Mayer Trio and bassist for The Who),[40] Flea (from the Red Hot Chili Peppers) and Alex Katunich (from Incubus). Spank bass developed from the slap and pop style and treats the electric bass as a percussion instrument, striking the strings above the pickups with an open palmed hand. Wooten popularized the "double thump," in which the string is slapped twice, on the upstroke and a downstroke (for more information, see Classical Thump). A rarely used playing technique related to slapping is the use of wooden dowel "funk fingers", an approach popularized by Tony Levin.

Picking techniques



Flea from the funk-rock band Red Hot Chili Peppers is known for his use of percussive slapping techniques.

The pick (or plectrum) is used to obtain a more articulate attack, for speed, or just personal preference. Although the use of a pick is primarily associated with rock and punk rock, picks are also used in other styles. Jazz bassist Steve Swallow uses a pick for upbeat or funky songs while Pink Floyd bassist Roger Waters uses one for a heavier tone. Picks can be used with alternating downstrokes and upstrokes, or with all downstrokes for a more consistent attack. The pick is usually held with the index and thumb, with the up-and-down plucking motion supplied by the wrist.

There are many varieties of picks available, but due to the thicker, heavier strings of the electric bass, bassists tend to use heavier picks than those used for electric guitar, typically ranging from 1.14 mm–3.00 mm (3.00 is unusual). Different materials are used for picks, including plastic, nylon, and felt, all of which produce different tones. Felt picks are used to emulate a fingerstyle tone.

Palm-muting techniques

Palm-muting is a widely used bass technique. The outer edge of the palm of the picking hand is rested on the bridge while picking, and “mutes” the strings, shortening the sustain time. The harder the palm presses, or the more string area that is contacted by the palm, the shorter the string’s sustain. The sustain of the picked note can be varied for each note or phrase. The shorter sustain of a muted note on an electric bass can be used to imitate the shorter sustain and character of an upright bass. Palm-muting is commonly done while using a pick, but can also be done without a pick, as when doing down-strokes with the thumb.

One prominent example of the pick/palm-muting combination is Paul McCartney, who has consistently used this technique for decades. Sting also uses palm-muting; but often does so without a pick, using the thumb and first finger to pluck.

Fretting techniques

The fretting hand—the left hand for right-handed bass players and the right hand for left-handed bass players—is used to press down the strings to play different notes and shape the tone or timbre of a plucked or picked note. The fundamental technique used in the fretting hand is known as "a finger per fret", where each finger in the fretting hand plays one fret in a given position.[41] The fretting hand can be used to change a sounded note, either by fully muting it after it is plucked or picked to shorten its duration or by partially muting it near the bridge to reduce the volume of the note, or make the note die away faster. The fretting hand is often used to mute strings that are not being played and stop the sympathetic vibrations, particularly when the player wants a "dry" or "focused" sound. On the other hand, the sympathetic resonance of harmonically related strings may be desired for some songs, such as ballads. In these cases, a bassist can fret harmonically related notes. For example, while fretting a sustained "F" (on the third fret of the "D" string), underneath an F major chord being played by a piano player, a bassist might hold down the "C" and low "F" below this note so their harmonics sound sympathetically.

The fretting hand can add vibrato to a plucked or picked note, either a gentle, narrow vibrato or a more exaggerated, wide vibrato with bigger pitch variations. For fretted basses, vibrato is always an alternation between the pitch of the note and a slightly higher pitch. For fretless basses, the player can use this style of vibrato, or they can alternate between the note and a slightly lower pitch. While vibrato is mostly done on "stopped" notes—that is, notes that are pressed down on the fingerboard—open strings can also be vibratoed by pressing down on the string behind the nut. As well, the fretting hand can be used to "bend" a plucked or picked note up in pitch. To create the opposite effect, a

"bend down", the string is pushed to a higher pitch before being plucked or picked and then allowed to fall to the lower, regular pitch after it is sounded. Though rare, some bassists may use a tremolo bar-equipped bass to produce the same effect.

In addition to pressing down one note at a time, bassists can also press down several notes at one time with their fretting hand to perform a chord. While chords are used less often by bassists than by electric guitarists, a variety of chords can be performed on the electric bass, especially with instruments with higher ranges such as six-string basses. Another variation to fully pressing down a string is to gently graze the string with the finger at the harmonic node points on the string, which creates chime-like upper partials. Glissando is an effect in which the fretting hand slides up or down the neck. A subtle glissando can be performed by moving the fretting hand without plucking or picking the string; for a more pronounced effect, the string is plucked or picked first, or, in a metal or hardcore punk context, a pick may be scraped along the sides of the strings.


Bassist Steve Harris of Iron Maiden is known for his fast bass "gallops"

The fretting hand can also be used to sound notes, either by plucking an open string with the fretting hand, or, in the case of a string that has already been plucked or picked, by "hammering on" a higher pitch or "pulling off" a finger to pluck a lower fretted or open stringed note. Jazz bassists use a subtle form of fretting hand pizzicato by plucking a very brief open string grace note with the fretting hand right before playing the string with the plucking hand. When a string is rapidly hammered on, the note can be prolonged into a trill.

Two-handed tapping

In the two-handed tapping styles, bassists use both hands to play notes on the fretboard by rapidly pressing and holding the string to the fret. Instead of plucking or picking the string to create a sound, in this technique, the action of striking the string against the fret or the fretboard creates the sound. Since two hands can be used to play on the fretboard, this makes it possible to play interweaving contrapuntal lines, to simultaneously play a bassline and a simple chord, or play chords and arpeggios. Bassist John Entwistle of The Who tapped percussively on the strings, causing them to strike the fretboard with a twangy sound to create drum-style fills. Players noted for this technique include Billy Sheehan, Stuart Hamm, John Myung, Victor Wooten, Les Claypool, Mark King and Michael Manring. The Chapman Stick and Warr Guitars are string instruments specifically designed to be played using two-handed tapping.


A bassist performing tapping, in which notes are sounded by striking the strings against the fretboard

Uses

Popular music

Popular music bands and rock groups use the bass guitar as a member of the rhythm section, which provides the chord sequence or "progression" and sets out the "beat" for the song. The rhythm section typically consists of a rhythm guitarist or electric keyboard player, or both, a bass guitarist and a drummer; larger groups may add additional guitarists, keyboardists, or percussionists. The types of basslines performed by the bass guitarist vary

widely from one style of music to another. Despite all of the differences in the styles of bassline, in most styles of popular music, the bass guitarist fulfills a similar role: anchoring the harmonic framework (often by emphasizing the roots of the chord progression) and laying down the beat (in collaboration with the drummer). The importance of the bass guitarist and the bass line varies in different styles of music. In some pop styles, such as 1980s-era pop and musical theater, the bass sometimes plays a relatively simple part, and the music forefronts the vocals and melody instruments. In contrast, in reggae, funk, or hip-hop, entire songs may be centered on the bass groove, and the bassline is usually very prominent in the mix.

In traditional country music, folk rock, and related styles, the bass often plays the roots and fifth of each chord in alternation. In Chicago blues, the electric bass often performs a walking bassline made up of scales and arpeggios. In blues rock bands, the bassist often plays blues scale-based riffs and chugging boogie-style lines. In metal, the bass guitar may perform complex riffs along with the rhythm guitarist or play a low, rumbling pedal point to anchor the group's sound.

The bass guitarist sometimes breaks out of the strict rhythm section role to perform bass breaks or bass solos. The types of basslines used for bass breaks or bass solos vary by style. In a rock band, a bass break may consist of the bassist playing a riff or lick during a pause in the song. In some styles of metal, a bass break may consist of "shred guitar"-style tapping on the bass. In a funk or funk rock band, a bass solo may showcase the bassist's percussive slap and pop playing. In genres such as progressive rock, art rock, or progressive metal, the bass guitar player may play melody lines along with the lead guitar (or vocalist) and perform extended guitar solos. Other contemporary musicians such as Edo Castro have taken the electric bass, including 4, 5, 6, 7, 8 & 9 strings, into a new and evolving genre centered entirely around the bass itself.

Jazz and jazz fusion

Double bassist and electric bassist Christian McBride performing in the jazz group "Five Peace Band" in 2008

The electric bass is a relative newcomer to the world of jazz. The big bands of the 1930s and 1940s Swing era and the small combos of the 1950s Bebop and Hard Bop movements all used the double bass. The electric bass was introduced during the late 1960s and early 1970s, when rock influences were blended with jazz to create jazz-rock fusion. The introduction of the electric bass in jazz fusion, as in the rock world, enabled the bass to be used in high-volume stadium concerts with powerful amplifiers, because it is much easier to amplify the electric bass than the double bass (the latter is prone to feedback in high-volume settings). The electric bass has both an accompaniment and a soloing role in jazz. In accompaniment, the bassist may perform walking basslines for traditional tunes and "jazz standards", playing smooth quarter note lines that imitate the double bass. For latin or salsa tunes and rock-infused jazz fusion tunes, the electric bass may play rapid, syncopated rhythmic figures in coordination with the drummer, or lay down a low, heavy groove.

In a jazz setting, the electric bass tends to have a much more expansive solo role than in most popular styles. In most rock settings, the bass guitarist may only have a few short bass breaks or brief solos during a concert. During a jazz concert, a jazz bassist may have a number of lengthy improvised solos, which are called "blowing" in jazz parlance. Whether a jazz bassist is comping (accompanying) or soloing, they usually aim to create a rhythmic drive and "timefeel" that creates a sense of "swing" and "groove". For information on notable jazz bassists, see the List of jazz bassists article.

Contemporary classical music

Contemporary classical music uses both the standard instruments of Western Art music (piano, violin, double bass, etc.) and newer instruments or sound producing devices, ranging from electrically amplified instruments to tape players and radios. The electric bass guitar has occasionally been used in contemporary classical music (art music) since the late 1960s. Contemporary composers often obtained unusual sounds or instrumental timbres through the use of non-traditional (or unconventional) instruments or playing techniques. As such, bass guitarists playing contemporary classical music may be instructed to pluck or strum the instrument in unusual ways.

Russian and Soviet composer Alfred Schnittke, pictured here in 1989, used electric bass for his Symphony no. 1 (1972).

American composers using electric bass in the 1960s included experimental classical music composer Christian Wolff (born 1934) (*Electric Spring 1*, 1966; *Electric Spring 2*, 1966/70; *Electric Spring 3*, 1967; and *Untitled*, 1996); Francis Thorne, a student of Paul Hindemith at Yale University (born 1922), who wrote (*Liebesrock* 1968–69); and Krzysztof Penderecki (Cello Concerto no. 1, 1966/67, rev. 1971/72), *The Devils of Loudun*, 1969; *Kosmogonia*, 1970; and *Partita*, 1971), Louis Andriessen (*Spektakel*, 1970; *De Staat*, 1972–76; *Hoketus*, 1976; *De Tijd*, 1980–81 and *De Materie*, 1984–1988). European composers who began scoring for the bass guitar in the 1960s included Danish composer Pelle Gudmundsen-Holmgreen (born 1932) (*Symfoni på Rygmarven*, 1966; *Rerepriser*, 1967; and *Piece by Piece*, 1968); Irwin Bazelon (*Churchill Downs*, 1970).

In the 1970s, electric bass was used by the American conductor-composer Leonard Bernstein (1918–1990) for his *MASS* (1971). American jazz pianist Dave Brubeck used bass guitar for his 1971 piece *Truth Has Fallen*. Russian and Soviet composer Alfred Schnittke used the instrument for his Symphony no. 1, 1972. In 1977, David Amram (born 1930) scored for electric bass in *En memoria de Chano Pozo*. Amram is an American composer known for his eclectic use of jazz, ethnic and folk music.

In the 1980s and 1990s, electric bass was used in works by Hans Werner Henze (*El Rey de Harlem*, 1980; and *Il ritorno d'Ulisse in patria*, 1981), Harold Shapero, *On Green Mountain (Chaconne after Monteverdi)*, 1957, orchestrated 1981; Steve Reich's *Electric Counterpoint* (1987), Wolfgang Rihm (*Die Eroberung von Mexico*, 1987–91), Arvo Pärt (*Miserere*, 1989/92), Steve Martland (*Danceworks*, 1993; and *Horses of Instruction*, 1994), Sofia Gubaidulina (*Aus dem Stundenbuch*, 1991), Giya Kancheli (*Wingless*, 1993), John Adams (*I Was Looking at the Ceiling and Then I Saw the Sky*, 1995; and *Scratchband*, 1996/97), and Michael Nyman (various works for the Michael Nyman Band).

Pedagogy and training

The pedagogy and training for the electric bass varies widely by genre and country. Rock and pop bass has a history of pedagogy dating back to the 1950s and 1960s, when method books were developed to help students learn the instrument. One notable method book was Carol Kaye's *How to Play the Electric Bass*.

In the jazz scene, since the bass guitar takes on much of the same role as the double bass—laying down the rhythm, and outlining the harmonic foundation—electric bass players have long used both bass guitar methods and jazz double bass method books. The use of jazz double bass method books by electric bass players in jazz is facilitated in that jazz methods tend to emphasize improvisation techniques (e.g., how to improvise walking basslines) and rhythmic exercises rather than specific ways of holding or plucking the instrument.

Formal training

Of all of the genres, jazz and the mainstream commercial genres (rock, R&B, etc.) have the most established and comprehensive systems of instruction and training for electric bass. In the jazz scene, teens can begin taking private lessons on the instrument and performing in amateur big bands at high schools or run by the community. Young adults who aspire to becoming professional jazz bassists or studio rock bassists can continue their studies in a variety of formal training settings, including colleges and some universities.

Several colleges offer electric bass training in the US. The Bass Institute of Technology (BIT) in Los Angeles was founded in 1978, as part of the Musician's Institute. Chuck Rainey (electric bassist for Aretha Franklin and Marvin Gaye) was BIT's first director. BIT was one of the earliest professional training program for electric bassists. The program teaches a range of modern styles, including funk, rock, jazz, Latin, and R&B.


Bassist Michael Manring is a well-known alumnus of the bass department of the Berklee College of Music.

The Berklee College of Music in Boston offers training for electric bass players. Electric bass students get private lessons and there is a choice of over 270 ensembles to play in. Specific electric bass courses include funk/fusion styles for bass; slap techniques for electric bass; fingerstyle R&B; five- and six-string electric bass playing (including performing chords); and how to read bass sheet music.[42] Berklee College alumni include Jeff Andrews, Victor Bailey, Jeff Berlin, Michael Manring, and Neil Stubenhaus.[42] The Bass Department has two rooms with bass amps for classes and ten private lesson studios equipped with audio recording gear. Berklee offers instruction for the four-, five-, and six-string electric bass, the fretless bass, and double bass. "Students learn concepts in Latin, funk, Motown, and hip-hop,...jazz, rock, and fusion."[42]

In Canada, the Humber College Institute of Technology & Advanced Learning offers an Advanced Diploma (a three-year program) in jazz and commercial music. The program accepts performers who play bass, guitar, keyboard, drums, melody instruments (e.g., sax, flute, violin) and who sing. Students get private lessons and perform in 40 student ensembles.[43]

Although there are far fewer university programs that offer electric bass instruction in jazz and popular music, some universities offer Bachelor's degrees (B.Mus.) and Master of Music (M.Mus.) degrees in jazz performance or "commercial music", where electric bass can be the main instrument. In the US, the Manhattan School of Music has a jazz program leading to B.Mus. and M.Mus degrees that accepts students who play bass (double bass and electric bass), guitar, piano, drums, and melody instruments (e.g., sax, trumpet, etc.).[44]

In the Australian state of Victoria, the Victorian Curriculum and Assessment Authority has set out minimum standards for its electric bass students doing their end-of-year Solo performance recital. To graduate, students must perform pieces and songs from a set list that includes Baroque suite movements that were originally written for cello, 1960s Motown tunes, 1970s fusion jazz solos, and 1980s slap bass tunes. A typical program may include a Prelude by J.S. Bach; "Portrait of Tracy" by Jaco Pastorius; "Twisted" by Wardell Gray and Annie Ross; "What's Going On" by James Jamerson; and the funky Disco hit "Le Freak" by Chic.[45]

In addition to college and university diplomas and degrees, there are a variety of other training programs such as jazz or funk summer camps and festivals, which give students the opportunity to play a wide range of contemporary music, from 1970s-style jazz-rock fusion to first decade of the 21st century-style R&B.

Informal training

In other less mainstream genres, such as hardcore punk or metal, the pedagogical systems and training sequences are typically not formalized and institutionalized. As such, many players learn "by ear", by copying the basslines from records and CDs, and by playing in a number of bands. Even in non-mainstream styles, though, students may be able to take lessons from experts in these or other styles, adapting learned techniques to their own style. As well, there are a range of books, playing methods, and, since the 1990s, instructional DVDs (e.g., on how to play metal bass).

Footnotes and references

[1] According to the New Grove Dictionary of Music and Musicians, an "Electric bass guitar [bass guitar] [is] a Guitar, usually with four heavy strings tuned E1'-A1'-D2-G2." *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London, 2001)

[2] The New Grove Dictionary of Music and Musicians defines the term *bass* thus: "Bass (iv). A contraction of Double bass or Electric bass guitar." Ibid.

[3] The proper term is "electric bass", and it is often misnamed "bass guitar", according to Tom Wheeler, *The Guitar Book*, pp 101–2. *Guitars* by Evans and Evans, page 342, agrees.

[4] Although "electric bass" is one of the common names for the instrument, "bass guitar" or "electric bass guitar" are commonly used and some authors claim that they are historically accurate (e.g., "How The Fender Bass Changed The World" in the references section).

[5] Bass guitar/Double Bass tuning E1=41.20 Hz, A1=55 Hz, D2=73.42 Hz, G2=98 Hz + optional low B0=30.87 Hz

[6] Standard guitar tuning E2=82.41 Hz, A2=110 Hz, D3=146.8 Hz, G3=196 Hz, B3=246.9 Hz, E4=329.6 Hz

[7] Model #736 Electric Bass Fiddle (http://www.bassic.ch/i_his_av.asp) (German text)

[8] Slog, John J.; Coryat, Karl [ed.] (1999). *The Bass Player Book: Equipment, Technique, Styles and Artists*. Backbeat Books. p. 154. ISBN 0879305738

[9] Book review of *How The Fender Bass Changed The World*. Available online at: http://blogcritics.org/books/article/how-the-fender-bass-changed-the/

[10] George, Nelson (1998). *Hip Hop America*. Viking Press. p. 91. ISBN 0670971532

[11] Bacon, Tony (2000). *50 Years of Fender*. Backbeat Books. p. 24. ISBN 0879306211

[12] Gibson EB-1 (http://homepage2.nifty.com/eb-1/top.html)

[13] http://www.vintageguitars.org.uk/EB2.php

[14] http://www.fuenfhunderteins.de/history.htm

[15] http://www.rickresource.com/rrp/axtbassarticle2.html

[16] http://www.vintageguitars.org.uk/adDetails/359

[17] There is a potted summary and description of graphite neck construction at http://wiki.basschat.co.uk/info:tech:use_of_composites_graphite_necks_in_bass_guitar_design.

[18] e.g., Status brand basses, which are made from graphite.

[19] Roberts, Jim (2001). 'How The Fender Bass Changed the World' or Jon Sievert interview with Bill Wyman, guitar player magazine December (1978)

[20] This fretless bass can be heard on The Rolling Stones songs such as "Paint it Black".

[21] In interviews, Pastorius gave various versions of how he accomplished this; the versions mention the use of pliers, a putty knife, and, in at least one interview (*Guitar Player* magazine, 1984) he states that he bought the instrument with the frets already removed, badly, with the slots where the frets once were not yet filled in.

[22] Pastorius used epoxy rather than varnish to obtain a glass-like finish suitable for the use of roundwound strings, which are otherwise much harder on the wood of the fingerboard.

[23] Tunings such as "BEAD" (this requires a low "B" string in addition to the other three "standard" strings), "D-A-D-G" (a "standard" set of strings, with only the lowest string detuned), and D-G-C-F or C-G-C-F (a "standard" set of strings, all of which are detuned) give bassists an extended lower range. A tenor bass tuning of "A-D-G-C" provides a higher range.

[24] Hipshots are similarly used to drop the "B"-string down to a "B♭" on five or six string basses where it is advantageous when accompanying brass bands whose music is commonly in the key of "B♭". More rarely, some bassists (e.g., Michael Manring) add detuners to more than one string, or even more than one detuner to each string, to enable them to detune strings during a performance and have access to a wider range of chime-like harmonics.

[25] Japanese manufacturer Atlansia offers one-, two- and three-stringed instruments (http://www.atlansia.jp/BASS.NEW.HTML#P8)

[26] Session bassist Tony Levin commissioned Music Man to build a three-string version of his favorite Stingray bass

[27] Tuned A-D-G-C, like the top 4 strings of a six-string bass, or simply a standard four-string with the strings each tuned up an additional perfect fourth. Tenor bass is a tuning used by Stanley Clarke, Victor Wooten, and Stu Hamm.

[28] Tuned "e-a-d-g" (an octave higher than standard bass tuning—the same as the bottom four strings of a guitar). This is used by jazz fusion bassists such as Stanley Clarke.

[29] The D-G-B-E tuning matches the first four strings (from highest to lowest) of a guitar, pitched two octaves lower.

[30] For example, an eight-string bass is strung Ee-Aa-Dd-Gg, while a 12-string bass might be tuned Eee-Aaa-Ddd-Ggg (four courses of three strings each). In the case of the 12-string, the standard pitch strings are augmented by two strings both an octave higher than the standard pitched string. Ten-string basses have octave strings added to the low-B of a five-string bass. A 15-string bass (tuned Eee Aaa Ddd Ggg Ccc) was developed by Jauqo III-X (http://www.jauqoiii-x.com/) and produced by Warrior Guitars(the 15 string bass made for Jauqo III-X by Warrior was the world's first 15-string bass guitar ever made. A 1998 video: http://www.youtube.com/watch?v=G6O0Lgyn6aE)

[31] These have a low "F#" string below the "B" string, and the nine-string bass adds a low "F#" and a high "B♭" string.

[32] The guitarbass has 10 strings on the same neck and body, but with separate scale lengths, bridges, fretboards, and pickups. It was created (http://www.microphoneheaven.com/guitarbass) by John Woolley in 2005, based on a prototype built by David Minnieweather.

[33] The Adler 12-string has the same range as the Bösendorfer 290 grand piano with 97 notes. This was made possible by Goodman developing an Ab4 string for the 32" scale.

[34] (e.g., the Jauqo III-X from 2000 or the sub-bass guitar, E-A-D-G one octave below standard ("E" being at 20.6 Hz)

[35] "IBANEZ RULES!! NAMM 2009 SR7" (http://www.ibanezrules.com/namm/2009/sr7.htm). Ibanezrules.com. . Retrieved 2010-02-07.

[36] These extended range sub-basses, Legend X YC and Legend XII YC, were built by luthier from Barcelona Jerzy Drozd (http://www.jerzydrozdbasses.com/). The 12 string Legend XII YC uses a new B string tuned at 15,4 hertz.

[37] Bass Musician Magazine: Yves Carbonne (http://www.bass-musician-magazine.com/General/bass-musician-magazine-masthead-detail.asp?directory-id=807599636)

[38] Bass Musician Magazine Article: "Why Fretless?" (http://www.bass-musician-magazine.com/General/bass-musician-magazine-detail.asp?year=2008&month=6&article-id=613057319)

[39] This is also known as the 'Vintage P' due to it being found on vintage basses before the invention of the split coil pickup. The single-coil "P" pickup is also used in the reissue and the Sting signature model.

[40] Jisi, Chris (2006). "The Master Stylist" (http://www.bassplayer.com/article/pino-palladino/nov-06/23886). *Bass Player Magazine Online Edition*. New Bay Media, LLC. . Retrieved 2008-12-27.

[41] http://basslessonsunlimited.com/Riley_Hagan.html

[42] "BERKLEE | Bass Department" (http://www.berklee.edu/departments/bass.html). Berklee.edu. . Retrieved 2010-02-07.

[43] "Humber College | Music" (http://postsecondary.humber.ca/music.htm). Postsecondary.humber.ca. . Retrieved 2010-02-07.

[44] "Manhattan School of Music: Undergraduate Studies" (http://www.msmnyc.edu/undergrad/). Msmnyc.edu. . Retrieved 2010-02-07.

[45] "Contemporary Double Bass" (http://www.vcaa.vic.edu.au/vce/studies/musicsolo/units34soloworks/sololist/electricbass.pdf) (PDF). . Retrieved 2010-02-07.

- Roberts, Jim (2001). *How The Fender Bass Changed the World*. San Francisco, CA: Backbeat Books. ISBN 0-87930-630-0.
- Wheeler, Tom (1978). *The Guitar Book: A Handbook for Electric and Acoustic Guitarists*. Harper & Row. ISBN 0-06-014579-X

Further reading

- Evans, Tom; Evans, Mary Anne (1977). *Guitars: From the Renaissance to Rock*. Facts On File. ISBN 0-87196-636-0
- Filiberto, Roger (1963). *The Electric Bass*. Mel Bay Publications
- Black, J. W. (2001). *The Fender Bass: An Illustrated History*. Hal Leonard. ISBN 0-63402-640-2

External links

- Weird Bass Guitars (http://www.weirdomatic.com/weird-bass-guitars.html) (Images)
- Bass fingering chart http://www.alfred.com/img/pdf/BOP/FingeringCharts/Electric_Bass.pdf

Acoustic guitar

An **acoustic guitar** is a guitar that uses only acoustic methods to project the sound produced by its strings. The term is a retronym, coined after the advent of electric guitars, which rely on electronic amplification to make their sound audible.

A modern acoustic guitar.

Sound production

In all types of guitars the sound is produced by the vibration of the strings. However, because the string can only displace a small amount of air, the volume of the sound needs to be increased in order to be heard. In an acoustic guitar, this is accomplished by using a soundboard and a resonant cavity, the sound box. The body of the guitar is hollow. The vibrating strings drive the soundboard through the bridge, making it vibrate. The soundboard has a larger surface area and thus displaces a larger volume of air, producing a much louder sound than the strings alone.

As the soundboard vibrates, sound waves are produced from both the front and back faces. The sound board provides both a support for the sound board and a resonant cavity and reflector for the sound waves produced on the back face of the soundboard. The air in this cavity resonates with the vibrational modes of the string and at low frequencies, which depend on the size of the box, the chamber acts like a Helmoltz resonator, increasing or decreasing the volume of the sound again depending on whether the air in the box is moving in phase or out of phase with the strings. When in phase, the sound is increased by about 3 decibels and when in opposing phase, it is decreased about 3 decibels. As a Helmholtz resonator, the air at the opening is vibrating in or out of phase with the air in the box and in or out of phase with the strings. These resonance interactions attenuate or amplify the sound at different frequencies, boosting or damping various harmonic tones. Also, the air in the box is coupled to the resonance of the top plate. Together, which cause further interactions. The back of the guitar will also vibrate to a lesser extent, driven by the air in the cavity. Some sound is ultimately projected through the sound hole[1] (some variants of the acoustic guitar omit this hole, or have f holes, like a violin family instrument). This sound mixes with the sound produced by the front face of the soundboard. All these complex air coupling interactions, along with the resonant properties of the panels, are a key reason that different guitars will have different tonal qualities. The sound is a complex mixture of harmonics that give the guitar its distinctive sound. No amplification actually occurs in this process, in the sense that no energy is externally added to increase the loudness of the sound (as would be the case with an electronic amplifier). All the energy is provided by the plucking of the string. The function of the entire acoustic system is to maximize intensity of sound, but since total energy remains constant, this comes at the expense of decay time. An unamplified guitar (one with no soundboard at all) would have a low volume, but the strings would vibrate much longer, like a tuning fork. This is because a damped harmonic oscillator decays exponentially, with a mean life inversely proportional to the damping, i.e. the more the volume is increased by the soundboard, the shorter the resulting sound will last.

Amplification

Many acoustic guitars incorporate rosettes around the sound hole.

An acoustic guitar can be amplified by using various types of pickups or microphones. The most common type of pickups used for acoustic guitar amplification are piezo and magnetic pickups. Piezo pickups are generally mounted under the bridge saddle of the acoustic guitar and can be plugged into a mixer or amplifier. Magnetic pickups are generally mounted in the sound hole of the acoustic guitar and are very similar to those found in electric guitars. An acoustic guitar with pickups for electrical amplification is known as an acoustic-electric guitar.The acoustic guitar is a bit difficult to amplify faithfully. As of recent, new types of pickups have been introduced to try to amplify the beautiful full sound of these instruments.This includes body sensors such as the Taylor Expression system, and systems that include an internal microphone along with the body sensors or under the saddle pickups.

Instruments with larger areas for the guitar top were introduced by Martin in an attempt to create louder volume levels. The popularity of the larger "dreadnought" body size amongst acoustic performers is related to the greater sound volume produced.

Sound can be produced on an acoustic guitar by using the fingers of the right hand (by right-handed guitarists) or by using a plectrum.

Types

A steel strung Yamaha APX700 electric-acoustic guitar

Historical and modern acoustic guitars are extremely varied in their design and construction, far more so than electric guitars. Some of the most important varieties are the classical guitar (nylon-stringed), steel-string acoustic guitar and lap steel guitar. A more complete list is given below, refer to the individual articles for more specific detail.

- **Nylon/gut stringed guitars**:
  - Renaissance guitar
  - Baroque guitar
  - Romantic guitar
  - Classical guitar, the modern version of the original guitar, with nylon strings
  - Flamenco guitar
  - Extended-range classical guitar
- **Steel stringed guitars**:
  - Steel-string acoustic guitar, also known as western, folk or country guitar
  - Twelve string guitar
  - Resonator guitar (such as the *Dobro*)
  - Archtop guitar
  - Battente guitar
  - Lap steel guitar

  - Parlor Guitar
  - Lyre-guitar
  - Weissenborn-style guitar
  - Manouche guitar
- Acoustic bass guitar
- Russian guitar
- Novelty instruments:
  - Pikasso guitar
  - Harp guitar
  - Banjo guitar
  - Guitar lute

References

[1] How a guitar works (http://www.phys.unsw.edu.au/music/guitar/guitarintro.html)

Library Acoustic Guitars (http://acousticguitars.awfl.net/)

External Links

- How To Play The Acoustic Guitar (http://www.rippingguitar.com/how-to-play-the-acoustic-guitar)

Didgeridoo

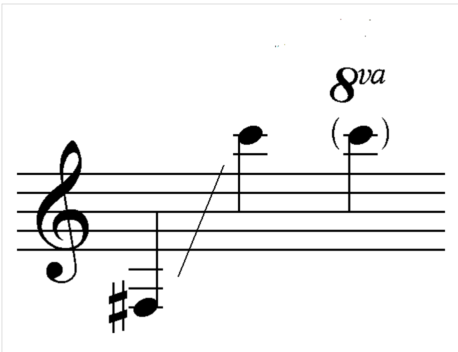
Didgeridoo

Top: Traditionally crafted & decorated
Middle: Bamboo souvenir didgeridoo
Bottom: Traditionally crafted & undecorated

Brass instrument	
Classification	• Wind • Aerophone
Hornbostel-Sachs classification	(Aerophone sounded by lip movement)

Playing range

Written range:



Related instruments

Trumpet, Flugelhorn, Cornet, Bugle,
Natural trumpet, Post horn, Roman tuba, Bucina, Shofar, Conch, Lur, Baritone horn, Bronze Age Irish Horn

The **didgeridoo** (also known as a **didjeridu** or **didge**) is a wind instrument developed by Indigenous Australians of northern Australia at least 1,500 years ago and is still in widespread usage today both in Australia and around the world. It is sometimes described as a natural wooden trumpet or "drone pipe". Musicologists classify it as a brass aerophone.[1]

There are no reliable sources stating the didgeridoo's exact age. Archaeological studies of rock art in Northern Australia suggest that the people of the Kakadu region of the Northern Territory have been using the didgeridoo for at least 1,500 years, based on the dating of paintings on cave walls and shelters from this period. A clear rock painting in Ginga Wardelirrhmeng, on the northern edge of the Arnhem Land plateau, from the freshwater period[2] shows a didgeridoo player and two songmen participating in an Ubarr Ceremony.[3]

A modern didgeridoo is usually cylindrical or conical, and can measure anywhere from 1 to 3 m (3 to 10 ft) long. Most are around 1.2 m (4 ft) long. The length is directly related to the 1/2 sound wavelength of the keynote.

Generally, the longer the instrument, the lower the pitch or key of the instrument.

Etymology

"Didgeridoo" is considered to be an onomatopoetic word of Western invention. It has also been suggested that it may be derived from the Irish words *dúdaire* or *dúidire*, meaning variously 'trumpeter; constant smoker, puffer; long-necked person, eavesdropper; hummer, crooner' and *dubh*, meaning "black" (or *dúth*, meaning "native").[4] However, this theory is not widely accepted.

The earliest occurrences of the word in print include a 1919 issue of Smith's Weekly where it was referred to as an "*infernal didjerry*" which "*produced but one sound - (phonic) didjerry, didjerry, didjerry and so on ad infinitum*", the 1919 *Australian National Dictionary*, *The Bulletin* in 1924 and the writings of Herbert Basedow in 1926. There are numerous names for this instrument among the Aboriginal people of northern Australia, with *yiḏaki* one of the better known words in modern Western society. *Yiḏaki*, also sometimes spelt *yirdaki*, refers to the specific type of instrument made and used by the Yolngu people of north-east Arnhem Land. However, Yolngu themselves are currently using the synonym *mandapul* to refer to the instrument, out of respect for the passing of a Manggalili-clan man in early 2011 whose name sounds similar to *yiḏaki*. Many didgeridoo enthusiasts and some scholars advocate reserving tribal names for tribal instruments, and this practice has been endorsed by some Aboriginal community organisations,[5] though in day-to-day conversation bilingual Aboriginal people will often use the word "didgeridoo" interchangeably with the instrument's name in their own language.

Regional names

There are at least 45 synonyms for the didgeridoo. The following are some of the more common regional names.[6]

Tribal Group	Region	Local Name
Anindilyakwa	Groote Eylandt	ngarrriralkpwina
Yolngu	Arnhem Land	Mandapul
Gupapuygu	Arnhem Land	Yiraka
Djinang	Arnhem Land	Yirtakki
Iwaidja	Cobourg Peninsula	Wuyimba/ buyigi
Jawoyn	Katherine	artawirr
Gagudju	Kakadu	garnbak
Lardil	Mornington Island	djibolu
Ngarluma	Roebourne, W.A.	Kurmur
Nyul Nyul	Kimberleys	ngaribi
Warray	Adelaide River	bambu
Mayali	Alligator River	martba
Pintupi	Central Australia	paampu
Arrernte	Alice Springs	Ilpirra

Construction and play


A wax mouthpiece can soften during play, forming a better seal.

Authentic Aboriginal didgeridoos are produced in traditionally oriented communities in Northern Australia or by makers who travel to Central and Northern Australia to collect the raw materials. They are usually made from hardwoods, especially the various eucalyptus species that are endemic to the region.[7] Sometimes a native bamboo, such as *Bambusa arnhemica*, or pandanus is used. Generally the main trunk of the tree is harvested, though a substantial branch may be used instead. Aboriginal didgeridoo craftsmen hunt for suitably hollow live trees in areas with obvious termite activity. Termites attack these living eucalyptus trees, removing only the dead heartwood of the tree, as the living sapwood contains a chemical that repels the insects. [8] Various techniques are employed to find trees with a suitable hollow, including knowledge of landscape and termite activity patterns, and a kind of tap or knock test, in which the bark of the tree is peeled back, and a fingernail or the blunt end of a tool, such as an axe is knocked against the wood to determine if the hollow produces the right resonance.[9]

Once a suitably hollow tree is found, it is cut down and cleaned out, the bark is taken off, the ends trimmed, and the exterior is shaped; this results in a finished instrument. This instrument may be painted or left undecorated. A rim of beeswax may be applied to the mouthpiece end. Traditional instruments made by Aboriginal craftsmen in Arnhem Land are sometimes fitted with a 'sugarbag' mouthpiece. This black beeswax comes from wild bees and has a distinctive aroma.

Non-traditional didgeridoos can also be made from PVC piping, non-native hard woods (typically split, hollowed and rejoined), glass, fiberglass, metal, agave, clay, hemp (a bioplastic named zelfo), and even carbon fiber. These didges typically have an upper inside diameter of around 1.25" down to a bell end of anywhere between two to eight inches and have a length corresponding to the desired key. The mouthpiece can be constructed of beeswax, hardwood or simply sanded and sized by the craftsman. In PVC, an appropriately sized rubber stopper with a hole cut into it is equally acceptable, or to finely sand and buff the end of the pipe to create a comfortable mouthpiece.

Modern didgeridoo designs are distinct from the traditional Australian Aboriginal didgeridoo, and are innovations recognized by musicologists.[10] [11] Didgeridoo design innovation started in the late 20th Century using non-traditional materials and non-traditional shapes.

The didgeridoo is played with continuously vibrating lips to produce the drone while using a special breathing technique called circular breathing. This requires breathing in through the nose whilst simultaneously expelling stored air out of the mouth using the tongue and cheeks. By use of this technique, a skilled player can replenish the air in their lungs, and with practice can sustain a note for as long as desired. Recordings exist of modern didgeridoo players playing continuously for more than 40 minutes; Mark Atkins on *Didgeridoo Concerto* (1994) plays for over 50 minutes continuously.

Fellow of the British Society Anthony Baines wrote that the didgeridoo functions "...as an aural kaleidoscope of timbres"[12] and that "the extremely difficult virtuoso techniques developed by expert performers find no parallel elsewhere."[12]

Decoration

Many didgeridoos are painted using traditional or modern paints by either their maker or a dedicated artist, however it is not essential that the instrument be decorated. It is also common to retain the natural wood grain with minimal or no decoration. Some modern makers deliberately avoid decoration if they are not of Indigenous Australian descent, or leave the instrument blank for an Indigenous Australian artist to decorate it at a later stage.

Physics and operation

A termite-bored didgeridoo has an irregular shape that, overall, usually increases in diameter towards the lower end. This shape means that its resonances occur at frequencies that are not harmonically spaced in frequency. This contrasts with the harmonic spacing of the resonances in a cylindrical plastic pipe, whose resonant frequencies fall in the ratio 1:3:5 etc. The second resonance of a didgeridoo (the note sounded by overblowing) is usually around an 11th higher than the fundamental frequency (a frequency ratio somewhat less than 3:1).

An Aboriginal man playing the Didgeridoo at Circular Quay

The vibration produced by the player's lips has harmonics, i.e., it has frequency components falling exactly in the ratio 1:2:3 etc. However, the non-harmonic spacing of the instrument's resonances means that the harmonics of the fundamental note are not systematically assisted by instrument resonances, as is usually the case for Western wind instruments (e.g., in a clarinet, the 1st 3rd and 5th harmonics of the reed are assisted by resonances of the bore, at least for notes in the low range).

Sufficiently strong resonances of the vocal tract can strongly influence the timbre of the instrument. At some frequencies, whose values depend on the position of the player's tongue, resonances of the vocal tract inhibit the oscillatory flow of air into the instrument. Bands of frequencies that are not thus inhibited produce formants in the output sound. These formants, and especially their variation during the inhalation and exhalation phases of circular breathing, give the instrument its readily recognizable sound.

Other variations in the didgeridoo's sound can be made by adding vocalizations to the drone. Most of the vocalizations are related to sounds emitted by Australian animals, such as the dingo or the kookaburra. To produce these sounds, the players simply have to use their vocal cords to produce the sounds of the animals whilst continuing to blow air through the instrument. The results range from very high-pitched sounds to much lower guttural vibrations. Adding vocalizations increases the complexity of the playing.

Cultural significance

Traditionally and originally, the didgeridoo was primarily played as an accompaniment to ceremonial dancing and singing. However, it was also common for didgeridoos to be played for solo or recreational purposes outside of ceremonial gatherings. For surviving Aboriginal groups of northern Australia, the didgeridoo is still an integral part of ceremonial life, as it accompanies singers and dancers in cultural ceremonies that continue. Today, the majority of didgeridoo playing is for recreational purposes in both Indigenous Australian communities and elsewhere around the world.

Pair sticks, sometimes called *clapsticks* or *bilma*, establish the beat for the songs during ceremonies. The rhythm of the didgeridoo and the beat of the clapsticks are precise, and these patterns have been handed down for many

generations. In the Wangga genre, the song-man starts with vocals and then introduces *blima* to the accompaniment of didgeridoo.[13] Traditionally, only men play the didgeridoo and sing during ceremonial occasions, although both men and women may dance. Female didgeridoo players did exist, but their playing took place in an informal context and was not specifically encouraged. Linda Barwick, an ethnomusicologist, says that though traditionally women have not played the didgeridoo in ceremony, in informal situations there is no prohibition in the Dreaming Law.[14] On September 3, 2008, however, publisher Harper Collins issued a public apology for its book "The Daring Book for Girls", scheduled to be published in October, which openly encouraged girls to play the instrument.[15] [16]

In popular culture


A didgeridoo being played by Tristin Chanel

The didgeridoo also became a role playing instrument in the experimental and avant-garde music scene. Industrial music bands like Test Department generated sounds from this instrument and used them in their industrial performances, linking ecology to industry, influenced by ethnic music and culture.

It has also been an instrument used for the fusion of tribal rhythms with a black metal sound, a music project called Naakhum that used the paganism of the Australian tribes and many others as an approach.

Health benefits

A 2005 study in the British Medical Journal found that learning and practicing the didgeridoo helped reduce snoring and sleep apnea by strengthening muscles in the upper airway, thus reducing their tendency to collapse during sleep.[17] This strengthening occurs after the player has mastered the circular breathing technique.

Selected bibliography

- Ah Chee Ngala, P., Cowell C. (1996): *How to Play the Didgeridoo - and history*. ISBN 0646328409
- Chaloupka, G. (1993): *Journey in Time*. Reed, Sydney.
- Cope, Jonathan (2000): *How to Play the Didgeridoo: a practical guide for everyone*. ISBN 0-9539811-0-X.
- Jones, T. A. (1967): "The didjeridu. Some comparisons of its typology and musical functions with similar instruments throughout the world". *Studies in Music* 1, pp. 23–55.
- Kaye, Peter (1987): "How to Play the Didjeridu of the Australian Aboriginal - A Newcomer's Guide.
- Kennedy, K. (1933): "Instruments of music used by the Australian Aborigines". *Mankind* (August edition), pp. 147–157.
- Lindner, D. (ed) (2005): *The Didgeridoo Phenomenon. From Ancient Times to the Modern Age*. Traumzeit-Verlag, Germany.
- Moyle, A. M. (1981): "The Australian didjeridu: A late musical intrusion". in *World Archaeology*, 12(3), 321–31.
- Neuenfeldt, K. (ed) (1997): *The didjeridu: From Arnhem Land to Internet*. Sydney: J. Libbey/Perfect Beat Publications.

References

[1] Brass Instruments, BBC (http://www.bbc.co.uk/dna/h2g2/A9567723)
[2] Kakadu National Park - Rock art styles (http://www.environment.gov.au/parks/kakadu/culture-history/art/styles.html)
[3] George Chaloupka, *Journey in Time*, p. 189.
[4] http://www.flinders.edu.au/news/articles/?fj09v13s02
[5] "Are "Didjeridu" and "Yidaki" the same thing?" (http://www.yirrkala.com/yidaki/dhawu/31samething.html). *Yidaki Dhawu Miwatjnurunydja*. Buku Larrngay Mulka Centre. . Retrieved 14 July 2011.
[6] The Didgeridoo and Aboriginal Culture (http://aboriginalart.com.au/didgeridoo/what_is.html) Aboriginal Australia Art and Culture Centre of Alice Springs
[7] Taylor R., Cloake J, and Forner J. (2002) Harvesting rates of a Yolgnu harvester and comparison of selection of didjeridu by the Yolngu and Jawoyn, *Harvesting of didjeridu by Aboriginal people and their participation in the industry in the Northern Territory* (ed. R. Taylor) pp. 25–31. Report to AFFA Australia. Northern Territory Parks and Wildlife Service, Department of Infrastructure, Planning and Environment, Palmerston, NT.
[8] McMahon, Charlie. (2004) The Ecology of Termites and Didjeridus, *The Didgeridoo: From Ancient Times to the Modern Age* (ed. David Lindner) Schönau: Traumzeit-Verlag
[9] "How is a Yidaki Made?" (http://www.yirrkala.com/yidaki/dhawu/08howmade.html). *Yidaki Dhawu Miwatjnurunydja*. Buku Larrngay Mulka Centre. . Retrieved 14 July 2011.
[10] Wade-Matthews, M., Thompson, W., *The Encyclopedia of Music*, 2004, pp184–185. ISBN 0-760-76243-0
[11] Wade-Matthews,M., *Illustrated Encyclopedia Musical Instruments*, 2003, Lorenz Books, p95. ISBN 1 357 91086 42
[12] A Baines, The Oxford Companion to Musical Instruments OUP 1992
[13] Elkin, A. P. (1979) [1938]. *The Australian Aborigines*. Angus & Robertson. Sydney, NSW. p. 290. ISBN 0-207-1-3863-X. Quoted at Manikay.Com (http://www.manikay.com/didjeridu/styles.shtml). Retrieved 17 April 2011.
[14] Women can play didgeridoo - taboo incites sales (http://www.bushcrafts.com.au/Info_pages/Can_women_play_didgeridoo.html)
[15] Didgeridoo book upsets Aborigines, BBC (http://news.bbc.co.uk/1/hi/world/asia-pacific/7595515.stm)
[16] 'Daring Book for Girls' breaks didgeridoo taboo in Australia (http://www.independent.co.uk/news/world/australasia/daring-book-for-girls-breaks-didgeridoo-taboo-in-australia-917751.html)
[17] Puhan MA, Suarez A, Lo Cascio C *et al.* (2005). "Didgeridoo playing as alternative treatment for obstructive sleep apnea syndrome: randomised controlled trial" (http://bmj.bmjjournals.com/cgi/content/full/332/7536/266). *BMJ* **332** (7536): 266–70. doi:10.1136/bmj.38705.470590.55. PMC 1360393. PMID 16377643. .

External links

- iDIDJ Australian Didgeridoo Cultural Hub (http://www.ididj.com.au/)
- Worldwide Didgeridoo Network - World's largest didgeridoo community with members from all over the world (http://didgeridoo.ning.com)
- The Didjeridu W3 Server (http://www.dreamtime-didjeriduw3server.com/)
- The physics of the didj (http://www.phys.unsw.edu.au/~jw/dij/dij.html)
- Didgeridoo acoustics (http://www.phys.unsw.edu.au/jw/didjeridu.html) from the University of New South Wales
- Database of audio recordings of traditional Arnhem Land music, samples included, many with didgeridoo (http://www.manikay.com)
- The Didjeridu: A Guide (http://www.gwiztraining.com/Didj Book.pdf) By Joe Cheal - General info on the didgeridoo, with citations and references
- BioloDidje (http://www.biolodidje.com) (translations available)
- Yidakiwuy Dhawu Miwatjngurunydja (http://www.yirrkala.com/yidaki/dhawu/) comprehensive site by traditional owners of the instrument

Harmonium

Harmonium

A Western harmonium

Free reed keyboard	
Hornbostel-Sachs classification	412.132 (Interruptive free aerophones; sets of free reeds)
Inventor(s)	Alexandre Debain
Developed	1840s
Related instruments	
Reed Organ, Organ	

A **harmonium** is a free-standing keyboard instrument similar to a reed organ. Sound is produced by air being blown through sets of free reeds, resulting in a sound similar to that of an accordion. The air is usually supplied by bellows operated by foot, hand, or knees.

In North America, the most common pedal-pumped free-reed keyboard instrument is known as the *American Reed Organ*, (or *parlor organ*, *pump organ*, *cabinet organ*, *cottage organ*, etc.) and along with the earlier *melodeon*, is operated by a suction bellows where air is sucked through the reeds to produce the sound. A *reed organ* with a pressure bellows, that pushes the air through the reeds, is referred to as a *harmonium*.

In much of Europe, the term "harmonium" is used to describe all pedal-pumped keyboard free-reed instruments, making no distinction whether it has a pressure or suction bellows.

In India, the term generally refers to a hand-pumped instrument.

A traditional wooden portable harmonium

History

For free reed history → Free reed aerophone History


A 1930 harmonium by Goldschmeding, from Holland

The harmonium was invented in Paris in the 1840s by Alexandre Debain, though there was concurrent development of similar instruments.[1] Christian Gottlieb Kratzenstein (1723–1795), Professor of Physiology at Copenhagen, was credited with the first free-reed to be made in the western world after winning the annual prize in 1780 from the Imperial Academy of St.Petersburg.[2]

Harmoniums reached the height of their popularity in the West in the late 19th and early 20th centuries. They were especially popular in small churches and chapels where a pipe organ would be too large or too expensive. Harmoniums generally weigh less than similarly-sized pianos and are not as easily damaged in transport, thus they were also popular throughout the colonies of the European powers in this period not only because it was easier to ship the instrument out to where it was needed, but it was also easier to transport overland in areas where good-quality roads and railways may have been non-existent. An added attraction of the harmonium in tropical regions was that the instrument held its tune regardless of heat and humidity, unlike the piano. This 'export' market was sufficiently lucrative for manufacturers to produce harmoniums with cases impregnated with chemicals to prevent woodworm and other damaging organisms found in the tropics.

At the peak of the instruments' Western popularity around 1900, a wide variety of styles of harmoniums were being produced. These ranged from simple models with plain cases and only 4 or 5 stops (if any at all), up to large instruments with ornate cases, up to a dozen stops and other mechanisms such as couplers. Expensive harmoniums were often built to resemble pipe organs, with ranks of fake pipes attached to the top of the instrument. Small numbers of harmoniums were built with two manuals (keyboards). Some were even built with pedal keyboards, which required the use of an assistant to run the bellows or, for some of the later models, an electrical pump. These larger instruments were mainly intended for home use, such as allowing organists to practise on an instrument on the scale of a pipe organ, but without the physical size or volume of such an instrument. For missionaries, chaplains in the armed forces, travelling evangelists, and the like, reed organs that folded up into a container the size of a very large suitcase or small trunk were made; these had a short keyboard and few stops, but they were more than adequate for keeping hymn-singers more-or-less on pitch.

The invention of the electronic organ in the mid-1930s spelled the end of the harmonium's success in the West (although its popularity as a household instrument declined in the 1920s as musical tastes changed). The Hammond organ could imitate the tonal quality and range of a pipe organ whilst retaining the compact dimensions and cost-effectiveness of the harmonium whilst reducing maintenance needs and allowing a greater number of stops and other features. By this time harmoniums had reached high levels of mechanical complexity, not only through the need to provide instruments with a greater tonal range, but (especially in North America) due to patent laws. It was common for manufacturers to patent the action mechanism used on their instruments, thus requiring any new manufacturer to develop their own version- as the number of manufacturers grew this led to some instruments having hugely complex arrays of levers, cranks, rods and shafts which made replacement with an electronic instrument even more attractive.

The last mass-producer of harmoniums in the West was the Estey company, which ceased manufacture in the mid-1950s. As the existing stock of instruments aged and spare parts became hard to find, more and more were either scrapped or sold. It was not uncommon for harmoniums to be 'modernised' by having electric blowers fitted, often very unsympathetically. The majority of Western harmoniums today are in the hands of enthusiasts, though the instrument remains popular in South Asia.

The South Asian harmonium has undergone changes, however, from the Western prototype. South Asian music is based on melody, rather than harmony, which makes two-handed playing unnecessary, and South Asian musicians are used to sitting cross-legged on the ground or kneeling to play, rather than on a chair or bench. Hence, the substructure has been removed, and the bellows moved to the back of the instrument, where they are operated with one hand while the other plays the keyboard. Drone-stops for a bagpipe-like effect have also been added.

Construction

Harmoniums consist of banks of brass reeds (metal tongues which vibrate when air flows over them), a pumping apparatus, stops for drones (some models feature a stop which causes a form of vibrato), and a keyboard. The harmonium's timbre, despite its similarity to the accordion's, is actually produced in a critically different way. Instead of the bellows causing a direct flow of air over the reeds, an external feeder bellows inflates an internal reservoir bellows inside the harmonium from which air escapes to vibrate the reeds. This design is similar to bagpipes as it allows the harmonium to create a continuously sustained sound. (Some better-class harmoniums of the 19th and early 20th centuries incorporated an “expression stop” which bypassed the reservoir, allowing a skilled player to regulate the strength of the air-flow directly from the pedal-operated bellows and so to achieve a certain amount of direct control over dynamics.) If a harmonium has two sets of reeds, it's possible that the second set of reeds (either tuned unison or an octave lower) can be activated by a stop, which means each key pressed will play two reeds. Professional harmoniums feature a third set of reeds, either tuned an octave higher or in unison to the middle reed. This overall makes the sound fuller. In addition, many harmoniums feature an octave coupler, a mechanical linkage that opens a valve for a note an octave above or below the note being played, and a scale changing mechanism, which allows one to play in various keys while fingering the keys of one scale.

Harmoniums are made with 1, 2, 3 and occasionally 6 sets of reeds. Classical instrumentalists usually use 1-reed harmoniums, while a musician who plays for a qawaali (Islamic devotional singing) usually uses a 3-reed harmonium.

India


Man playing a harmonium. He is pumping the bellows of the harmonium with one hand and playing the keys with the other.


Harmonium close up

During the mid-19th century missionaries brought French-made hand-pumped harmoniums to India. The instrument quickly became popular there: it was portable, reliable and easy to learn. It has remained popular to the present day, and the harmonium remains an important instrument in many genres of Indian music. It is commonly found in Indian homes. Though derived from the designs developed in France, the harmonium was developed further in India in unique ways, such as the addition of drone stops and a scale changing mechanism.

In Kolkata, Dwarkanath Ghose of the Dwarkin company modified the imported harmony flute and developed the hand held harmonium, which has subsequently become an integral part of the Indian music scenario.[3] Dwijendranath Tagore is credited with having used the imported instrument in 1860 in his private theatre, but it was probably a pedal-pumped instrument which was cumbersome, or possibly some variation of the reed organ. Initially, it aroused curiosity but gradually people started playing it[4] and Ghose took the initiative to modify it.[3] It was in response to the Indian needs that the hand-held harmonium was introduced. All Indian musical instruments are played with the musician sitting on the floor or on a stage, behind the instrument or holding it in his hands. In that era, Indian homes did not use tables and chairs.[3] Also, Western music being harmonically based, both a player's hands were needed to play the chords, thus assigning the bellows to the feet was the best solution; Indian music being melodically based, only one hand was necessary to play the melody, the other hand was free for the bellows.

The harmonium was widely accepted in Indian music, particularly Parsi and Marathi stage music, in the late 19th century. By the early 20th century, however, in the context of nationalist movements that sought to depict India as utterly separate from the West, the harmonium came to be portrayed as an unwanted foreigner. Technical concerns with the harmonium included its inability to produce meend (slides between notes) and the fact that, once tuned, it cannot be adjusted in the course of performance. The former prevents it from articulating the subtle inflections (such as andolan, gentle oscillation) so crucial to many ragas; the latter prevents it from articulating the subtle differences in intonational color between a given svara in two different ragas. For these reasons, it was banned from All-India Radio from 1940 to 1971. (Indeed, a ban still stands on harmonium solos.) On the other hand, many of the harmonium's qualities suited it very well for the newly-reformed classical music of the early 20th century: it is easy for amateurs to learn; it supports group singing and large voice classes; it provides a template for standardized raga grammar; it is loud enough to provide a drone in a concert hall. For these reasons, it has become the instrument of choice for accompanying most North Indian classical vocal genres, though it is still despised due to its foreign origin by some connoisseurs of Indian music, who prefer the sarangi as an accompanying instrument for khyal singing.

A popular usage is by followers of the Hindu and Sikh faiths, who use it to accompany their devotional songs (bhajan or kirtan). There is at least one harmonium in any mandir (Hindu temple) or gurdwara (Sikh temple) around the world.

The harmonium is commonly accompanied by the tabla as well as a dholak. To Sikhs, the harmonium is known as the vaja/baja. It is also referred to as a "Peti" (A loose reference to a "Box") in some parts of North India and Maharashtra.

The harmonium plays an integral part in Qawwali music. Almost all Qawwals use the harmonium as their sole musical accompaniment. It has received international exposure as the genre of Qawwali music has been popularized by renowned Pakistani musicians, including Nusrat Fateh Ali Khan.

There is some discussion of Indian harmonium-makers producing reproductions of Western-style reed organs for the export trade.

22 Shruti harmonium

Vidyadhar Oke has developed a 22-shruti harmonium, which can play the 22 Indian Shrutis (microtones) in an octave, as required in Indian classical music. [5] The fundamental tone (Shadja) and the fifth (Pancham) are fixed, but the other ten notes have two microtones each, one higher and one lower. The higher microtone is selected by pulling out a knob below the key. In this way, the 22-shruti harmonium can be tuned for any particular raga by simply pulling out knobs wherever a higher shruti is required.

Samvadini

Bhishmadev Vedi is said to have been the first to contemplate improving the instrument by augmenting it with a string box like a harp attached to the top of the instrument. His disciple, Manohar Chimote, later implemented this concept and also provided the name "Samvadini" to this instrument - this name has now gained widespread acceptance. Bhishmadev Vedi is also have said to been among the first to contemplate and design compositions specifically for the harmonium, styled along the lines of "tantakari" - performance of music on stringed instruments. These compositions tend to have a lot of cut-notes and high speed passages creating in some ways an effect similar to that of a string being plucked.

Samvadini - a modified version of harmonium to perform solo on the instrument.

Harmonium Acoustics

The acoustical effects described below are a result of the free reed mechanism. Therefore they are essentially identical for the Western and Indian harmoniums and the reed organ.

History

In 1875, Hermann von Helmholtz published his seminal book, *On the Sensations of Tone*, in which he used the harmonium extensively to test different tuning systems:[6]

> "Among musical instruments, the harmonium, on account of its uniformly sustained tone, the piercing character of its quality of tone, and its tolerably distinct combinational tones, is particularly sensitive to inaccuracies of intonation. And as its vibrators also admit of a delicate and durable tuning, it appeared to me peculiarly suitable for experiments on a more perfect system of tones."[7]

Using two manuals and two differently tuned stop sets, he was able to simultaneously compare Pythagorean to just and to equal-tempered tunings and observe the degrees of inharmonicity inherent to the different temperaments. He

subdivided the octave to 28 tones, to be able to perform modulations of 12 minor and 17 major keys in just intonation without going into harsh dissonance that is present with the standard octave division in this tuning.[8] This arrangement was noted to be difficult to play on.[9] Additional modified or novel instruments were described to be used for experimental and educational purposes were described. Notably, Bosanquet's "Generalized keyboard", which was constructed in 1873 for the use with a 53-tone scale. In practice, that harmonium was constructed with 84 keys, for convenience of fingering. Another famous reed organ that was evaluated was built by Poole.[10]

Lord Rayleigh also used the harmonium to devise a method for indirectly measuring frequency accurately, using approximated known equal temperament intervals and their overtone beats.[11] The harmonium had the advantage of providing clear overtones that enabled the reliable counting of beats by two listeners, one per note. However, Rayleigh acknowledged that maintaining constant pressure in the bellows is difficult and fluctuation of the pitch occurs rather frequently as a result.

Timbre

Reed organ frequencies depend on the blowing pressure; the fundamental frequency *decreases* with medium pressure compared to low pressure, but it *increases* again at high pressures by several hertz for the bass notes measured.[12] American reed organ measurements showed a sinusoidal oscillation with sharp pressure transitions when the reed bends above and below its frame.[13] The fundamental itself is nearly the mechanical resonance frequency of the reed.[14] The overtones of the instrument are harmonics of the fundamental, rather than inharmonic,[15] although a weak inharmonic overtone (6.27*f*) was reported too.[16] The fundamental frequency comes from a traverse mode, whereas weaker higher traverse and torsional modes were measured too.[17] Any torsional modes are excited because of a slight asymmetry in the reed's construction. During attack, it was shown that the reed produces most strongly the fundamental, along with a second transverse or torsional mode, which are transient.[17]

Radiation patterns and coupling effects between the sound-box and the reeds on the timbre appear to have not been studied to date.

Dynamics

The unusual reed vibration physics have a direct effect on harmonium playing, as the control of its dynamics in playing is restricted and subtle. The free reed of the harmonium is riveted from a metal frame and is subjected to airflow, which is pumped from the bellows through the reservoir, pushing the reed and bringing it to self-exciting oscillation and to sound production in the direction of airflow.[13] This particular aerodynamics is nonlinear in that the maximum displacement amplitude in which the reed can vibrate is limited by fluctuations in damping forces, so that the resultant sound pressure is rather constant.[15] Additionally, there is a threshold pumping pressure, below which the reed vibration is minimal.[16] Within those two thresholds, there is an exponential growth and decay in time of reed amplitudes .[18]

Classical repertoire (Western music)

The harmonium repertoire includes many pieces written originally for the church organ, which may be played on a harmonium as well because have a small enough range and use fewer stops. For example, Bach's Fantasia in C major for organ BWV 570 [19] is suitable for a 4-octave harmonium.

A harmonium.

- Anton Bruckner, Symphony no. 7, an arrangement for chamber ensemble, prepared in 1921 by students and associates of Arnold Schoenberg for the Viennese Society for Private Musical Performances, was scored for 2 violins, viola, cello, bass, clarinet, horn, piano 4-hands, and harmonium. The Society folded before the arrangement could be performed, and it was not premiered for more than 60 years.
- Alban Berg. Altenberg Lieder
- William Bergsma. *Dances from a New England Album, 1856* for orchestra. It includes parts for melodeon (movements I-III) and harmonium (movement IV).
- William Bolcom. *Songs of Innocence and of Experience* for orchestra, choirs, and soloists, includes parts for melodeon, harmonica, and harmonium.
- Frederic Clay. *Ages Ago*, an early work by features a harmonium part (libretto by W. S. Gilbert)
- Claude Debussy. Prélude à l'après-midi d'un faune, a chamber ensemble arrangement by Arnold Schoenberg
- Antonín Dvořák. Five Bagatelles for 2 violins, cello and harmonium Op. 47 (B.79)
- Edward Elgar. Sospiri, Adagio for String Orchestra, Op. 70 (scored for harp or piano and harmonium or organ)
- César Franck. The final collection of pieces popularly known as L'Organiste (1889–1890) was actually written for harmonium, some pieces with piano accompaniment
- Alexandre Guilmant. author of many duos for piano and harmonium, including:
  - *Symphonie tirée de la Symphonie-Cantate "Ariane"* (Op. 53)
  - *Pastorale A-Dur* (Op. 26)
  - *Finale alla Schumann sur un noël languedocien* (Op. 83)
- Paul Hindemith. Hin und zurück (There and Back), an operatic sketch which uses a harmonium for its stage music.
- Sigfrid Karg-Elert. Various works for solo harmonium.
- Kronos Quartet. *Early Music*, an album that has several pieces featuring harmonium.
- Henri Letocart (1866–1945). 25 Pièces pour harmonium, Premier cahier
- Franz Liszt. Symphonie zu Dantes Divina Commedia, Movement II: Purgatorio
- Gustav Mahler. Symphony No. 8
- George Frederick McKay. "*Sonata for Clarinet and Harmonium*" (1929) (also adaptable to piano or violin)
- Martijn Padding. "*First Harmonium Concerto*," (2008) for harmonium and ensemble [20]
- Gioachino Rossini. *Petite Messe Solennelle* is scored for piano and harmonium
- Arnold Schoenberg. Herzgewächse Op. 20 for high soprano, celesta, harp and harmonium
- Franz Schreker. Chamber Symphony
- Richard Strauss. "Ariadne auf Naxos," an opera (libretto by Hugo von Hoffmansthal), which employs a harmonium in the orchestration of each of its versions. It requires an instrument with many stops, which are specified in the score.
- Vierne. Louis. 24 Pièces en style libre pour organ ou harmonium, Op. 31 (1913)
- Zemlinsky, Alexander
  - Six Maeterlinck Songs
  - Lyric Symphony

Nordic folk music

Harmonium played a significant part in the new rise of Nordic folk music, especially in Finland. In the late 70's, a harmonium could be found in most schools where the bands met, and it became natural for the bands to include harmonium in their setup. A typical folk band then — particularly in Western Finland — consists of violin(s), double-bass and harmonium. There was a practical limitation that prevented playing harmonium and accordion in the same band: harmoniums were tuned to 438 Hz while accordions were tuned to 442 Hz.[21]

Some key harmonium players in the new rise of Nordic folk have been Timo Alakotila and Milla Viljamaa.

Use in Western popular music

- Steve Adey (Scottish singer songwriter) uses a harmonium on many songs from his 2006 album *All Things Real*.[22]
- Tori Amos toured with it in 1996 during her Boys For Pele tour.
- Sara Bareilles has used a harmonium to accompany herself in live performances of "Kaleidoscope Heart", a song from her album Kaleidoscope Heart.
- The Beatles used it in many recordings, including "Doctor Robert", "The Inner Light", "We Can Work It Out", "Cry Baby Cry", "Being for the Benefit of Mr. Kite", "Rocky Raccoon", "The Word" and in the final chord of "A Day in the Life".
- Jeff Buckley used a harmonium on the introduction of the song "Lover, You Should Have Come Over" from the album Grace.
- Future of Forestry used a harmonium in "Slow your Breath Down" from their album *Travel II EP*.
- Allen Ginsberg, in a rare 1970s recording called *First Blues: Rags, Ballads and Harmonium Songs*, in which he sets his poetry to music, "accompanies himself with a small hand-pumped harmonium from India".[23]
- David Gray has used a harmonium extensively in his live shows, most notably on the Lost and Found tour in support of Foundling.
- Lisa Hannigan uses a harmonium extensively in her album *Sea Sew*.[24]
- The National are also known to use a harmonium on occasion, with extensive use on their album *High Violet*.[25]
- Nico in most of the post-Velvet Underground career is characterized by her accompanying herself on harmonium in songs with a Gothic style that used drone, especially on her albums *The Marble Index* (1969), *Desertshore* (1970) and *The End...* (1974).
- Mumford & Sons makes use of the harmonium in many of its songs.
- Radiohead used an antique harmonium on "Motion Picture Soundtrack" on *Kid A*. They toured with the instrument throughout 2001 until it broke during a show in Oxford, England on July 7.
- Shilpa Ray and her Happy Hookers, an Indie music band, uses an Indian harmonium, played by Shilpa Ray herself as her lead instrument.[26]
- Sigur Rós use the harmonium on many of their tracks, including Samskeyti and on acoustic versions of "Vaka", "Starálfur", Heysátan and "Von" on double EP *Hvarf/Heim*.
- Talk Talk used a harmonium, played by Tim Friese-Greene, on their albums *Spirit of Eden* and *Laughing Stock*.
- Tom Waits plays on the harmonium on his albums *Swordfishtrombones* and *Rain Dogs* and it appears also on *Night on Earth*, the soundtrack of Jim Jarmusch's film that bears the same title.

Additionally, the song "Music for a Found Harmonium", named after the instrument, appears in a variety of movies, including *Napoleon Dynamite*.

References

[1] "History of the reed organ" (http://www.harmoniums.com/hist_en.htm). . Retrieved 2010-08-06.
[2] "Western Free Reed Instruments" (http://www.patmissin.com/history/western.html). . Retrieved 2010-08-06.
[3] "The Invention of Hand Harmonium" (http://web.archive.org/web/20070409051040/http://dwarkin.com/dwarkinaboutus.htm). Dwarkin & Sons (P) Ltd.. Archived from the original (http://www.dwarkin.com/dwarkinaboutus.htm) on 2007-04-09. . Retrieved 2007-04-24.
[4] Khan, Mobarak Hossain. "Harmonium" (http://banglapedia.search.com.bd/HT/H_0070.htm). *Banglapedia*. Asiatic Society of Bangladesh. . Retrieved 2007-04-24.
[5] http://www.22shruti.com
[6] Helmholtz, L. F., and Ellis, A., *On the Sensations of Tone*, London: Longmans, Green, And Co., 1875.
[7] Helmholtz, H. L. F., 1875, p. 492, Part III, Justly-Intoned Harmonium.
[8] Helmholtz, H. L. F., 1875, p. 634, Appendix. XVII.
[9] Helmholtz, H. L. F., 1875, p. 682, Appendix. XIX.
[10] Helmholtz, H. L. F., 1875, p. 677, Appendix. XIX.
[11] Rayleigh (Jan 1879). "On the determination of absolute pitch by the common harmonium". *Nature* **19** (482): 275-276.
[12] Cottingham, J. P., Reed, C. H. & Busha, M. (Mar 1999). "Variation of frequency with blowing pressure for an air-driven free reed" (http://www.public.coe.edu/~jcotting/BERLIN2.PDF). *Collected Papers of the 137th meeting of The Acoustical Society of America and the 2nd Convention of the European Acoustics Association: Forum Acusticum, Berlin*. .
[13] Cottingham, J. P. (Sep 2007). "Reed Vibration in Western Free-Reed Instruments" (http://www.public.coe.edu/~jcotting/ICA2007 Free Reed.pdf). *Proceedings of the International Congress on Acoustics (ICA2007), Madrid, Spain*. .
[14] Fletcher, N. H. & Rossing, T. D. (1998). *The physics of musical instruments, 2nd ed.*. Springer Science+Media Inc.. p. 414.
[15] St. Hilaire, A. O. (1976). "Analytical prediction of the non-linear response of a self-excited structure". *Journal of Sound and Vibration* **47** (2): 185-205.
[16] Cottingham, J. P., Lilly, J. & Reed, C. H. (Mar 1999). "The motion of air-driven free reeds" (http://www.public.coe.edu/~jcotting/BERLIN1.PDF). *Collected Papers of the 137th meeting of The Acoustical Society of America and the 2nd Convention of the European Acoustics Association: Forum Acusticum, Berlin*. .
[17] Paquette, A & Cottingham, J. P. (Nov 2003). "Modes of Vibration of Air-driven Free Reeds in Steady State and Transient Oscillation" (http://www.public.coe.edu/~jcotting/Ammon-2003.pdf). *137th meeting of The Acoustical Society of America, Austin Texas*. .
[18] St. Hilaire, A. O., Wilson, T. A. & Beavers, G. B. (1971). "Aerodynamic excitation of the harmonium reed". *Journal of Fluid Mechanics* **49** (4): 803-816.
[19] http://imslp.org/wiki/Fantasia_in_C_major,_BWV_570_%28Bach,_Johann_Sebastian%29
[20] http://www.martijnpadding.nl/compositions/uitgebreid.php?id=84
[21] http://www.pelimanni.net/materiaali/harmooni.htm **(Finnish)**
[22] http://www.pennyblackmusic.co.uk/MagSitePages/Article.aspx?id=4000
[23] http://www.folkways.si.edu/albumdetails.aspx?itemid=2041
[24] http://southasia.typepad.com/south_asia_daily/2009/03/the-harmonium-and-lisa-hannigan.html
[25] http://thequietus.com/articles/03978-the-national-reveal-high-violet-collaborators
[26] "Shilpa Ray, Shilpa Ray and Her Happy Hookers" (http://www.npr.org/buckets/music/women/artist.php?artistId=97). NPR. 2011-05-19. . Retrieved 2011-05-19.

External links

- Chisholm, Hugh, ed (1911). "Harmonium". *Encyclopædia Britannica* (11th ed.). Cambridge University Press.

Thumb piano

The **thumb piano** is an African musical instrument, a type of plucked idiophone common throughout Sub-Saharan Africa.

A Zimbabwean *mbira dza vadzimu*.

Description

Each note of a kalimba, mbira, *kaffir piano* etc. is a separate idiophone, and in orchestral terms, the instrument as a whole belongs in the bar percussion family (specifically: lamellophones). Furthermore, the thumbs are not exclusively used, as some instruments are played with the thumbs and other fingers also.

Thumb pianos traditionally consist of a wooden board to which metal tines of varying lengths are affixed. Some have mechanisms for readily tuning the tines to different scales. The longest tines are typically in the center, with shorter (and thus higher-pitched) tines arranged alternately in ascending order towards both sides of the instrument. The thumb piano is most commonly held in both hands, with both thumbs being used to pluck tines either simultaneously or in turn

Modern variations of the instrument may have more than the traditional array of 15 tines, with as many as four fully chromatic octaves, making the playing of more complex music possible. The thumb pianos are made of different woods, either with only a sound board or often with a resonant chamber. Those with hollow resonating chambers for increased volume, often have two holes on the back that can be used to create a vibrato as the fingers cover and open these holes.

Acoustics

Lamellophones are instruments which have little tines, or "lamellae", which are played by plucking. Unlike stringed instruments or air-column instruments like flutes, the overtones of a plucked lamella are inharmonic (i.e., the overtones and the fundamental vibration do not harmonize), giving the kalimba a rather odd sound. However, the inharmonic overtones are strongest in the attack and die out rather quickly, leaving an almost pure tone which is quite beautiful.

The tuning of most kalimbas, with the notes in the scale ascending on the tines from the center outward in an alternating right-left fashion, results in chords being made by adjacent tines. When any tine is plucked, the adjacent tines also vibrate, and these harmonizing secondary vibrations serve a similar role to the harmonic overtones of a string instrument - they increase the harmonic complexity of an individual note, though in a strange yet pleasing way.

Tines on the Array Mbira are arranged so that the most consant intervals (octaves, fifths, and fourths) vibrate along with the fundamental. Furthermore, each tine is bent at a certain angle to produce overtones (most notably the 6th harmonic, or two octaves plus a fifth) that are more consonant.

History

Various kinds of thumb pianos have existed in Africa for thousands of years. The keys were originally made of bamboo but over the years metal keys have been developed. The instrument is known by different names in different regions of Africa, including **Mbira**, **Mbila**, **Mbira Huru**, **Mbira Njari**, **Mbira Nyunga**, **Marimba**, **Karimba**, **Kalimba**, **Likembe**, **Okeme**, as well as **marímbula** (also called **kalimba**) in the Caribbean Islands.

The kalimba appears to have been invented twice in Africa: a wood or bamboo-tined instrument appeared on the west coast of Africa about 3000 years ago, and metal-tined lamellophones appeared in the Zambezi River valley around 1,300 years ago (Kubik, 1998). These metal-tined instruments traveled all across the continent and differentiated in their physical form and social uses as they spread. Kalimba-like instruments came to exist from the northern reaches of North Africa to the southern extent of the Kalahari desert, and from the east coast to the west coast, though many or most groups of people in Africa did not possess kalimbas. There were thousands of different tunings, different note layouts, and different instrument designs, but there is a compelling case from Andrew Tracey about a hypothetical tuning and note layout of the original metal-tined instrument from 1,300 years ago.

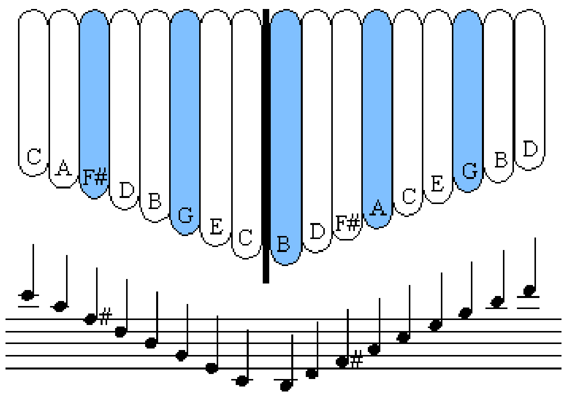
The thumb piano was typically played while walking by traveling Griots, African poet bards who keep the history of the tribe or village, and to entertain people with songs, stories, poems, dances, etc. It was thought in ancient times that the thumb piano was able to project its sound into the heavens and could draw down spirits to the earth. Some of them were evil spirits so the people would stop playing the music until the spirits had departed from the area.

Many players and griot clans have their own idiosyncratic tunings. Most of the time the instrument is played solo and tuning is not as critical as when playing with other musicians. But the tuning can be changed by adjusting the length of the metal tines inward or outward. It is also often an important instrument to be played at religious ceremonies, weddings, and other social gatherings. It is a particularly common musical instrument of the Democratic Republic of Congo and the Shona people of Zimbabwe.

In the mid 1900’s the instrument was the basis for the development of the Kalimba, a westernized thumb piano designed and marketed by the ethnomusicologist Hugh Tracey. This has become very important in popularizing the instrument outside of Africa. While the arrangement of notes on a thumb piano is considerably different from those on a piano or guitar, their arrangement is fairly intuitive, and it is considered to be an instrument easily learned. This quality is exploited in many elementary schools who use the thumb piano as an entry-level instrument. One of its indigenous names for this instrument can be translated as “The thing that makes walking easier” and as such it could be considered “the first walkman.”

Tunings

Most western instruments have a simple linear visual mapping from the instrument to the pitch which is played: on a piano, the further left you go, the lower you go, and higher notes are to the right. String instruments have a similar mapping – the further up the neck you go, the lower the pitch – but this progression is realized independently on each string. Most western string instruments have a similar progression from one string to the next: each violin string, for example, is a perfect 5th higher than the previous one. Such consistent spatial mappings from the instrument to the pitches it plays promotes the development of intuition and aids in the learning of the instrument and even the ability to improvise or play by ear.



Tuning chart for the 17-note treble kalimba.

It is common on African mbira and other lamellophones to have the lowest notes in the center with higher notes to the far left and the far right - this is an ergonomic nicety, in that the thumb can pivot such that all the tines are easy to reach. However, traditional African tunings use notes that do not lie on the grid of the western tempered scale, and traditional kalimba note layouts are often idiosyncratic, sometimes with adjacent tines making part of a scale, but then an odd note thrown in that defies the pattern.

The Hugh Tracey kalimbas are tuned diatonically in the key of G. The arrangement of the notes on the Hugh Tracey kalimba borrows from the typical scheme with the lowest notes in the center and the upper notes on the left and the right, but a regular note layout is used, with the notes in the ascending scale alternating strictly right-left and going outwards towards the two sides. With this bidirectional note layout, it seems that all intuition from linearly mapped instruments goes out the window. This arrangement requires that the kalimba player develop a new intuition, but that new intuition is not as hard to come by as the more idiosyncratic note layouts of the traditional African lamellophones.

The diatonic western kalimba tuning Hugh Tracey used was practical for a worldwide instrument - with hundreds of African kalimba tunings, the chosen western standard would maximize the number of people who would immediately connect with the kalimba. The beauty of this note arrangement, with notes going up the scale in a right-left-right-left progression, is that modal 1-3-5 or 1-3-5-7 chords are made by playing adjacent tines and are trivial to learn and play. If chords are played in the lower octave, the same notes will appear on the opposite side of the kalimba in the upper octave, which makes it very easy to simultaneously play a melody in the upper octave and an accompanying harmony in the lower octave. So, the arrangement of notes on the Hugh Tracey kalimba (and on virtually any kalimba you find, as this note layout scheme has been adopted by virtually everyone who copies the Hugh Tracey kalimba) makes some complex musical operations very simple and easy.

Alternative tunings are possible, as the tines of most kalimbas are easily pushed in and out to sharpen or flatten their pitch. Some alternative tunings simply change the key of the kalimba, without changing the note layout scheme. Other alternative tunings move the kalimba to non-modal scales (such as Middle-Eastern scales). Each note of the kalimba can be tuned independently (unlike a guitar), so any scale, western or non-western, is possible, and traditional African scales are still accessible to this modern African instrument. Composer Georg Hajdu has tuned the Hugh Tracey alto kalimba to the chromatic steps of the Bohlen–Pierce scale in a piece called *Just Her - Jester - Gesture*. The Bohlen–Pierce scale subdivides the just twelfth into 13 steps.

The Chromatic Kalimba is also a fairly new instrument. There are a few different makers of the chromatic kalimba. One is the Hugh Tracey/AMI 2 octave kalimba which ranges from the G below middle C up to the G above the top line of the treble clef. The accidentals are mounted on the rear side of the kalimba as flats right under their adjacent parent note from the top. Recently, (2010) Aaron Chavez modeled an idea for the 4 octave chromatic kalimba utilizing octaves C2-C6. JBH Guitars is the original maker of this 4 octave chromatic.

Other variants

A special type of thumb piano is the Array mbira, consisting of as many as 150 tines configured in a special order based on the circle of fifths (see Isomorphic keyboard.) The Guitaret is an electric lamellophone made by Hohner and invented by Ernst Zacharias, in 1963.[1]

In the late 20th century instrument builder and musician Robert Grawi was inspired by playing cross rhythms on a thumb piano to create a new westernized African instrument called the gravikord. It is an electric double harp made of modern materials mostly stainless steel tubing. The tuning is based on the "G" tuning of the kalimba but its overall structure is based on the West African kora. It has 24 notes evenly divided between two ranks of strings in notches on a free standing double bridge. Tones rise in a strictly alternate right/left hand symmetry familiar to any kalimba or thumb piano player, so that any tunes and techniques that are learned on these instruments can also be played on the gravikord.[2]

Kalimba

A Hugh Tracey treble kalimba

Popularity

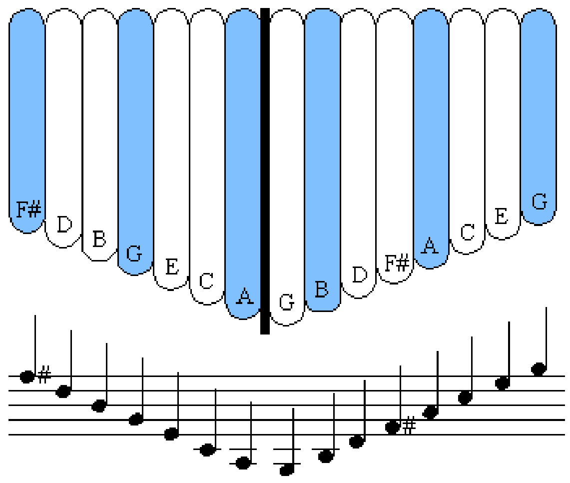
Hugh Tracey, an English ethnomusicologist who moved to Africa in 1920, spent several years from the 1920s through the 1950s traveling about in rural Africa (i.e., as far away as he could get from western musical influences such as radio, eastern-influenced bands, and Christian missionaries) where he recorded traditional music and documented the tunings and note layouts of the different kalimbas. However, when Hugh Tracey founded the company African Musical Instruments and started building kalimbas in Rudespoort, South Africa, and exporting them around the world in 1954, the note layout and tuning were not traditional. Rather, the kalimbas were tuned diatonically in the key of G, with adjacent notes on the scale sitting on opposite sides of the kalimba.

The first kalimba to be exported commercially out of Africa was the Hugh Tracey Kalimba. After years of studying African music and dozens of prototype instruments, Hugh Tracey's company African Musical Instruments also began manufacturing kalimbas, a western version of the mbira, in the late 1950s. The name kalimba is a Bantu word which means "little music", and is similar to the word karimba, a type of mbira.

While kalimba initially meant the Hugh Tracey kalimba, the name kalimba is now a generic name and can describe any non-traditional thumb piano, or can even be used generically for the traditional lamellophones of Africa (i.e., the mbira, karimba, sansa, etc.).

In the early 1960s, Hugh Tracey secured an initial order of 10,000 kalimbas with Creative Playthings of Princeton NJ, a company which designed and distributed innovative toys and furniture, mostly made from natural materials. And so, many people bought their first kalimba from a toy store. People quickly realized that the kalimba was not a toy, but a real instrument capable of real music.

Soon, African Musical Instruments began making other styles of kalimba with similar, but different note layouts. The original kalimba was named the Treble, and a larger, lower pitched 15-note model called the Alto was introduced. See the ALTO tuning chart below:



Tuning chart for the 15-note alto kalimba.

Similarly, different kalimba models with the same note layout were also introduced over time. Most traditional African kalimbas had the tines mounted on a flat board, rather than on a box, though some traditional kalimbas were mounted on a piece of wood which was hollowed out to provide a resonant box. The flat board kalimbas could be placed inside or on top of a hollow gourd, which was used as a resonator to amplify and alter the quality of the sound the kalimba produced. The new board-mounted Hugh Tracey kalimbas were a nod to the traditional African kalimba designs. The smaller board-mounted Hugh Tracey kalimbas were given the name "celleste" (as in "celleste treble").

Shortly after the Hugh Tracey kalimba started being sold around the world, artisans and craftspeople started copying the design, or adapting the design. Several high quality kalimba makers exist around the world today: Lucinda Ellison, Andrew Masters, David Bellinger, Steve Catania, Luc DeCock, R. P. Collier, and Greg Trimble. On the other hand, most kalimbas sold today are inexpensive copies made in third world countries such as Pakistan or Indonesia.

African Musical Instruments continues to produce high quality kalimbas from their shop in South Africa. They have expanded their offerings to over a dozen different kalimba models, ranging from an 8-note student model to a modern version of a traditionally tuned Shona karimba. AMI also makes high quality marimbas and drums.

A few artists, including Genesis, Earth, Wind & Fire, Jo Mango, King Crimson, John Mayer, Laura Barrett, and Vampire Weekend have also incorporated the kalimba into Western pop and rock music styles.

Maurice White, the Founder and Leader of the popular group Earth, Wind & Fire, gave immense exposure to the Kalimba in the band's music. Earth, Wind & Fire recordings such as "Kalimba Story", "Evil", "Biyo" and "Departure", all revolved around White's electrified Kalimba solos. The Kalimba also proved to be an iconic symbol of the band's reflection of African-ism.

Use in New Music

Finally, the kalimba also found its way into the domain of New Music where it is often used together with live-electronics. In his composition *kalimBAO* (2006), Sascha Lino Lemke uses a Kalimba with microtonal tunings, whereas in Karlheinz Essl's *Sequitur XIV* the kalimba is processed with a custom-made computer program. Both pieces were premiered by pianist Jennifer Hymer who also specializes in Kalimba performance.

A Kalimba (or Mbira) playing the opening theme from Pink Floyd's "A Saucerful of Secrets" along with milk-bottle flute introduces the first tune "I Believe in Milko" from The Ninth Tentacle's first album for the Cellartapes record-label: Voyeuradeism.

The 2007 tribute record "Four Songs by Arthur Russell" features Swedish singer-songwriter Jens Lekman using a kalimba in his rendition of Russell's "A Little Lost". While he had initially played ukulele for the cover (as broadcast live on the radio series "No Love For Ned" 21 February 2005), Lekman thereafter frequently featured the kalimba version in his live sets for a period.

In the late 20th century instrument builder and musician Robert Grawi was inspired by playing cross rhythms on the kalimba to create another new westernized African instrument called the gravikord. It is an electric double harp made of modern materials mostly stainless steel. The tuning is based on the "G" tuning of the kalimba but its structure is based on the West African kora. It has 24 notes evenly divided between two ranks of strings which rise in a strictly

alternate right/left hand symmetry familiar to any kalimba player, so that any tunes and techniques that are learned on the kalimba can also be played on this instrument.

The kalimba was used by James Horner in the soundtrack to ALIENS, specifically in the cue "The Complex" (6-M-1).

References

[1] Hohner: Guitaret Manual, Trossingen Germany 1963
[2] The Gravikord web site : http://www.gravikord.com/instrument.html#gravikord

Further reading

- Warner Dietz, Betty and Olatunji, Michael Babatunde. (1965). Musical Instruments of Africa: Their Nature, Use, and Place in The Life of a Deeply Musical People. New York: John Day Company.

External links

- http://www.kalimbamagic.com/
- http://www.asza.com/ikalim.shtml
- http://ilam.ru.ac.za/
- http://www.kalimba.co.za/
- http://www.nscottrobinson.com/mbira.php
- http://www.youtube.com/kalimbamagic
- http://www.music.vt.edu/musicdictionary/textk/Kalimba.html The tuning diagrams are incorrect.
- http://www.acoustics.org/press/155th/chapman.htm David M.F. Chapman "The Sound of the African Thumb Piano (kalimba), Acoustics '08, Paris.
- World Musical Instrument Database (http://www.arcmusic.org/begin.html). New York: Archive of Contemporary Music

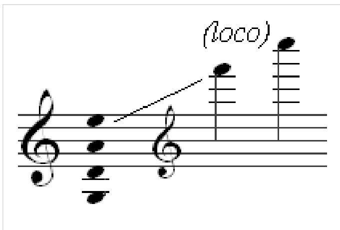
Mandolin

Mandolin

A Glenn F5 Fern mandolin

String instrument	
Classification	String instrument Plucked string instrument
Hornbostel-Sachs classification	321.321-6 (Composite chordophone sounded by a plectrum)
Developed	Mid 18th century from the mandolino

Playing range



(a regularly tuned mandolin with 14 frets to body)

Related instruments

- **Family**
  - Mandolin
  - Mandola
  - Octave mandolin
  - Mandocello
  - Mandobass
- Angélique (instrument)
- Archlute
- Balalaika
- Barbat (lute)
- Bağlama
- Biwa
- Bouzouki
- Charango
- Chitarra Italiana
- Daguangxian
- Đàn tỳ bà
- Dombra

- Domra
- Dutar
- Electric pipa
- Erhu
- Irish bouzouki
- Kobza
- Liuqin
- Lute
- Mandriola
- Oud
- Pandura
- Pipa
- Rubab
- Setar
- Sitar
- Surbahar
- Tanbur
- Tanbur (Turkish)
- Tembûr
- Theorbo
- Tiorbino
- Tiqin
- Topshur
- Tricordia
- Ukulele
- Veena
- Zhonghu

A **mandolin** (Italian: *mandolino*) is a musical instrument in the lute family (plucked, or strummed). It descends from the mandore, a soprano member of the lute family. The mandolin soundboard (the top) comes in many shapes—but generally round or teardrop-shaped, sometimes with scrolls or other projections. A mandolin may have f-holes, or a single round or oval sound hole. A round or oval sound hole may be bordered with decorative rosettes or purfling, but usually doesn't feature an intricately carved grille like a Baroque era mandolin.[1] [2]

Early mandolins had six double courses of gut strings, tuned similarly to lutes, and plucked with the fingertips. Modern mandolins—which originated in Naples, Italy in the late 18th century—commonly have four double courses (four pairs) of metal strings, which are plucked with a plectrum.

Many variants of the mandolin have existed. These include Milanese, Lombard, Brescian and other 6-course types, as well as four-string (one string per course), twelve-string (three strings per course), and sixteen-string (four strings per course).

Construction

Weber F-5-style mandolin (f-holes)

A-5-style mandolin (f-holes)

Example of an A-4-style mandolin (oval hole)

A mandolin typically has a hollow wooden body with a tailpiece that holds one end of the strings, a floating bridge, a neck with a flat (or slight radius) fretted fingerboard, a nut, and mechanical tuning machines to accommodate metal strings.

Like any plucked instrument, mandolin notes decay to silence rather than sound out continuously as with a bowed note on a violin. Its small size and higher pitch make mandolin notes decay faster than larger stringed instruments like guitar, which encourages the use of tremolo (rapid picking of one or more pairs of strings) to create sustained notes or chords. The mandolin's paired strings facilitate this technique: the plectrum (pick) strikes each of a pair of strings alternately, providing a more full and continuous sound than a single string would.

Various design variations and amplification techniques have been used to make mandolins compatible in volume with louder instruments and orchestras. Hybridization with the louder banjo creates the mandolin-banjo, and resonators have been used, most notably by Dobro and the National String Instrument Corporation. Some musicians play electric mandolins through amplifiers.

Variations

Bowlback


1930 National Triolian resonator mandolin from Lowell Levinger's collection

Mandolins come in several forms. The Neapolitan style, known as a round-back or bowl-back (or "tater-bug," colloquial American) has a vaulted back made of a number of strips of wood in a bowl formation, similar to a lute, and usually a canted, two-plane, uncarved top. Another form has a banjo-style body.

Archtop

At the very end of the nineteenth century, a new style, with a carved top and back construction inspired by violin family instruments began to supplant the European-style bowl-back instruments, especially in the United States. This new style is credited to mandolins designed and built by Orville Gibson, a Kalamazoo, Michigan luthier who founded the "Gibson Mandolin-Guitar Manufacturing Co., Limited" in 1902. Gibson mandolins evolved into two basic styles: the Florentine or F-style, which has a decorative scroll near the neck, two points on the lower body, and usually a scroll carved into the headstock; and the A-style, which is pear shaped, has no points, and usually has a simpler headstock.


1926 Paramount Style A Banjo Mandolin from Lowell Levinger's collection

These styles generally have either two f-shaped soundholes like a violin (F-5 and A-5), or an oval sound hole (F-4 and A-4 and lower models) directly under the strings. Much variation exists between makers working from these archetypes, and other variants have become increasingly common. Generally, Gibson F-hole F-5 mandolins and mandolins influenced by that design are strongly associated with American bluegrass music, while the A-style is more associated with Irish, folk, or classical music. The F-5s more complicated woodwork also translates into a more expensive instrument.


Carved (acoustic-electric) and Neapolitan (round-backed) mandolins—front

Internal bracing to support the top in the F-style mandolins is usually achieved with parallel tone bars, similar to the bass bar on a violin. Some makers instead employ "x-bracing," which is two tone bars mortised together to form an X. Some luthiers now using a "modified x-bracing" that incorporates both a tone bar and x-bracing.

Numerous modern mandolin makers build instruments that largely replicate the Gibson F-5 Artist models built in the early 1920s under the supervision of Gibson acoustician Lloyd Loar. Original Loar-signed instruments are sought after and extremely valuable. Other makers from the Loar period and earlier include Lyon and Healy, Vega, and Larson Brothers. Notable modern American mandolin manufacturers include Weber, Monteleone, and Collings. Mandolins from other countries include The Loar (China), Michael Kelly (Korea), Eastman (China), Kentucky(China), and Morgan Monroe(China).


Carved and Neapolitan (round-backed) mandolins—back

Others

Other American-made variants include the mandolinetto or Howe-Orme guitar-shaped mandolin (manufactured by the Elias Howe Company between 1897 and roughly 1920), which featured a cylindrical bulge along the top from fingerboard end to tailpiece; the Army-Navy style with a flat back and top; and the Vega mando-lute (more commonly called a cylinder-back mandolin manufactured by the Vega Company between 1913 and roughly 1927), which had a similar longitudinal bulge but on the back rather than the front of the instrument.

As with almost every other contemporary string instrument, another modern variant is the electric mandolin. These mandolins can have four or five individual or double courses of strings.

History

Mandolins evolved from the lute family in Italy during the seventeenth and eighteenth centuries, and the deep bowled mandolin, produced particularly in Naples, became common in the nineteenth century. The original instrument was the mandore, which evolved in the fourteenth century from the lute. Over time and as the instrument spread around Europe, it took on many names and various structural characteristics.

Further back, dating to around 15,000 BC to 8000 BC, single-stringed instruments have been seen in cave paintings and murals. They were struck, plucked, and eventually bowed. From these, the families of stringed instruments developed. Single strings were long and gave a single melody line. To shorten the scale length, other strings were added with a different tension and pitch so one string took over where another left off. In turn, this led to being able to play dyads and chords. The bowed family became the rabob, and then the rebec fiddle, evolving into the modern violin family by 1520 (incidentally also in Italy). The plucked family led to lute-like instruments in 2000 BC Mesopotamia, and developed into the *oud* or *ud* before appearing in Spain, first documented around 711 AD, courtesy of the Moors.

Over subsequent centuries, the strings were doubled to courses, and eventually (in Europe) frets were added, leading to the first lute appearing in the thirteenth century. The history of the lute and the mandolin are intertwined from this point. The lute gained a fifth course by the fifteenth century, a sixth a century later, and up to thirteen courses in its heyday. As early as the fourteenth century a miniature lute or *mandora* appeared. Like the mandola, it had counterparts in Assyria (pandura), the Arab countries (dambura), and Ukraine (kobza-bandura). From this, the *mandolino* (a small cat gut-strung mandola with six strings tuned g b e' a' d *g* sometimes called the *Baroque mandolin* or *cat-banjo* and played with a quill, wooden plectrum or finger-style) was developed in several places in Italy. A nearly identical instrument called the mandore was used in France at the same time. The mandolino was sometimes called a *mandolin* in the early eighteenth century (around 1735) Naples. At this point, all such instruments were strung with gut strings.

The first evidence of modern steel-strung mandolins is from literature regarding popular Italian players who traveled through Europe teaching and giving concerts. Notable are Signor Leone and G. B. Gervasio, who traveled widely between 1750 and 1810.[2] This, with the records gleaned from the Italian Vinaccia family of luthiers in Naples, Italy, led some musicologists to believe that the modern steel-strung mandolin was developed in Naples by the Vinaccia family. Gennaro Vinaccia was active c. 1710 to c. 1788, and Antonio Vinaccia was active c. 1734 to c.

1796.[3] An early extant example of a mandolin is one built by Antonio Vinaccia in 1772, which resides at the Victoria and Albert Museum in London, England. Another is by Giuseppe Vinaccia, built in 1763, residing at the Kenneth G. Fiske Museum of Musical Instruments in Claremont, California.[4] The earliest extant mandolin was built in 1744 by Gaetano Vinaccia. It resides in the Conservatoire Royal de Musique in Brussels, Belgium.[5]

These mandolins, like their modern descendants, are called *Neapolitan* mandolins because they originate in Naples, Italy. They are distinguished by an almond-shaped body with a bowled back constructed from curved strips of wood along its length. The sound table is bent just behind the bridge, the bending achieved with a heated bending iron. This "canted" table helps the body support a greater string tension. A hardwood fingerboard is flush with the soundtable. Ten metal or ivory frets are spaced along the neck in semitones, with additional frets glued upon the soundtable. The strings are brass except for the lowest string course, which are gut or metal wound onto gut. The bridge is a movable length of hardwood or ivory placed in front of ivory pins that hold the strings. Wooden tuning pegs are inserted through the back of a flat pegboard. The mandolins have a tortoise shell pickguard below the soundhole under the strings. A quill or shaped piece of tortoise shell is used as a plectrum.[5] [6]

Other luthiers who built mandolins included Rafaele Calace (1863 onwards) in Naples, Luigi Embergher (1856–1943) in Rome, the Ferrari family (1716 onwards, also originally mandolino makers) in Rome, and De Santi (1834–1916) in Rome. The Neapolitan style of mandolin construction was adopted and developed by others, notably in Rome, giving two distinct but similar types of mandolin — Neapolitan and Roman.

The twentieth century saw the rise in popularity of the mandolin for Celtic, bluegrass, jazz, and classical styles. Much of the development of the mandolin from Neapolitan bowl-back to the flat-back style (actually, gently rounded and carved like a violin) is attributable to Orville Gibson (1856–1918). See above.

Tuning

A variety of different tunings are used. Usually, courses of 2 adjacent strings are doubled (tuned to the same pitch). The most common tuning by far, GDAE, is the same as violin tuning:

- fourth (lowest tone) course: G3 (196.00 Hz)
- third course: D4 (293.66 Hz)
- second course: A4 (440.00 Hz; A above middle C)
- first (highest tone) course: E5 (659.25 Hz)

Frets 1-12 — etc. to fret ~22

to tuners — to bridge

Nut	1	2	3	4	5	6	7	8	9	10	11	12
E	F	F#	G	G#	A	A#	B	C	C#	D	D#	E
A	A#	B	C	C#	D	D#	E	F	F#	G	G#	A
D	D#	E	F	F#	G	G#	A	A#	B	C	C#	D
G	G#	A	A#	B	C	C#	D	D#	E	F	F#	G
				*		*			*		**	

* = fret marker

Other tunings exist, including "cross-tunings," in which the usually doubled string runs are tuned to different pitches. Additionally, guitarists may sometimes tune a mandolin to mimic a portion of the intervals on a standard guitar tuning to achieve familiar fretting patterns.

Mandolin family

The mandolin is the soprano member of the mandolin family, as the violin is the soprano member of the violin family. Like the violin, its scale length is typically about 13 inches (330 mm). Modern American mandolins modeled after Gibsons have a longer scale, about 13-7/8" (352 mm).

1920 Gibson F-4 mandolin, 1917 Gibson H-2 mandola, 1924 Gibson K-4 mandocello, and 1929 Gibson mando-bass, from Gregg Miner's collection

Other members of the mandolin family are:

- The **mandola** (US and Canada), termed the ***tenor mandola*** in Britain and Ireland and ***liola*** or ***alto mandolin*** in continental Europe, which is tuned to a fifth below the mandolin, in the same relationship as that of the viola to the violin. Some also call this instrument the "alto mandola." Its scale length is typically about 16.5 inches (420 mm). It is normally tuned like a viola: C-G-D-A.
- The **octave mandolin** (US and Canada), termed the ***octave mandola*** in Britain and Ireland and ***mandola*** in continental Europe, which is tuned an octave below the mandolin. Its scale length is typically about 20 inches (500 mm), although instruments with scales as short as 17 inches (430 mm) or as long as 21 inches (530 mm) are not unknown.

L-R - Banjo-mandolin, standard mandolin, 3-course mandolin, Tenor mandola.

- The **mandocello,** which is classically tuned to an octave plus a fifth below the mandolin, in the same relationship as that of the cello to the violin: C-G-D-A. Today, it is frequently restrung for octave mandolin tuning or the Irish bouzouki's GDAD. Its scale length is typically about 25 inches (635 mm). A typical violoncello scale is 27" (686 mm).
- The Greek **laouto** is essentially a mandocello, ordinarily tuned D-G-D-A, with half of each pair of the lower two courses being tuned an octave high on a lighter gauge string. The body is a staved bowl, the saddle-less bridge glued to the flat face like most ouds and lutes, with mechanical tuners, steel strings, and tied gut frets. Modern laoutos, as played on Crete, have the entire lower course tuned in octaves as well as being tuned a reentrant octave above the expected D. Its scale length is typically about 28 inches (712 mm).
- The **mando-bass,** has 4 single strings, rather than double courses, and is tuned like a double bass or an acoustic bass guitar. These were made by the Gibson company in the early twentieth century, but appear to have never been very common. Reportedly, most mandolin orchestras preferred to use the ordinary double bass, rather than a specialised mandolin family instrument. Calace and other Italian makers predating Gibson also made mandolin-basses.

- The **piccolo** or **sopranino mandolin** is a rare member of the family, tuned one octave above the tenor mandola and one fourth above the mandolin; the same relation as that of the piccolo or sopranino violin to the violin and viola. One model was manufactured by the Lyon & Healy company under the Leland brand. A handful of contemporary luthiers build piccolo mandolins. Its scale length is typically about 9.5 inches (240 mm).
- The **Irish bouzouki** is also considered a member of the mandolin family; although derived from the Greek bouzouki, it is constructed like a flat backed mandolin and uses fifth-based tunings, most often GDAE (an octave below the mandolin), although sometimes GDAD, ADAD or ADAE are used in place of the guitar-like fourths-and-third tunings of the three- and four-course Greek bouzouki. Although the bouzouki's bass course pairs are most often tuned in unison, on some instruments one of each pair is replaced with a lighter string and tuned in octaves, in the fashion of the 12-string guitar. Although occupying the same range as the **octave mandolin/octave mandola,** the Irish bouzouki is distinguished from the former instrument by its longer scale length, typically from 22 inches (560 mm) to 24 inches (610 mm), although scales as long as 26 inches (660 mm), which is the usual Greek bouzouki scale, are not unknown.

1911 Leland piccolo mandolin, from Gregg Miner's collection

- The modern **cittern** is also an extension of the mandolin family, being typically a five course (ten string) instrument having a scale length between 20 inches (500 mm) and 22 inches (560 mm). It is most often tuned to either DGDAD or GDADA, and is essentially an octave mandola with a fifth course at either the top or the bottom of its range. Some luthiers, such as Stefan Sobell also refer to the octave mandola or a shorter-scaled Irish bouzouki as a cittern, irrespective of whether it has four or five courses.
- In Indian classical music and Indian light music, the mandolin, which bears little resemblance to the European mandolin, is likely to be tuned to E-B-E-B. As there is no concept of absolute pitch in Indian classical music, any convenient tuning maintaining these relative pitch intervals between the strings can be used. Another prevalent tuning with these intervals is C-G-C-G, which corresponds to Sa-Pa-Sa-Pa in the Indian carnatic classical music style. This tuning corresponds to the way violins are tuned for carnatic classical music.

Mandolin music

Mandolins have a long history, and much early music was written for them. In the first half of the 20th century, they enjoyed a period of great popularity in Europe and the Americas as an easier approach to playing string music. Many professional and amateur mandolin groups and orchestras were formed to play light classical string repertory. Just as this practice was falling into disuse, the mandolin found a new niche in American country, old-time music, bluegrass, and folk music. More recently, the Baroque and Classical mandolin repertory and styles have benefited from the raised awareness of and interest in Early music. Tremolo and fingerpicking methods are used while playing a mandolin.

Australia

The earliest references to the mandolin in Australia come from Phil Skinner MBE (1903–1991). In his article "Recollections"[7] he mentions a Walter Stent, who was "active in the early part of the century and organised possibly the first Mandolin Orchestra in Sydney." He also refers to Roy Smedley, a student of Walter Stent, who performed on the radio and "was a most outstanding mandolinist, prominent over many years; his technique, choice of solos and stage presentation left little to be desired, and the students he produced did him great honour".

Phil Skinner played a key role in the development of the mandolin movement in Australia in the 20th Century and was awarded an MBE in 1979 for services to music and the community. He was born Harry Skinner in Sydney in 1903 and started learning music at age 10 when his uncle (who couldn't read music) tutored him on the banjo. Phil began teaching part time at age 18 years until the Depression Years forced him to begin teaching full time and learn a broader range of instruments. Phil founded the Sydney Mandolin Orchestra, the oldest surviving mandolin orchestra in Australia.

On 30 January 1976, Harry Baker of the Fremantle Music School in Western Australia organised a meeting to consider forming a mandolin orchestra in Fremantle. Seventeen interested people attended and decide to proceed. News of this is published in the Independent Post on 4 February 1976 along with an appeal for more players. Robert Schulz, a music teacher, is appointed conductor. The Fremantle-Coburn News announced that the Fremantle Music School had put together a mandolin group consisting of 8 players (2 of each: 1st & 2nd mandolin, mandola, guitar), but looking for 30-40 others. Initially called the Fremantle Mandolin Orchestra, it later became the West Australian Mandolin Orchestra(WAMO), which survives today (2009) with approx 30 players.

By 1974, a mandolin ensemble called Varianten has formed in Geelong, Victoria and eventually becomes the Geelong Mandolin Orchestra (GMO).

The Sydney Mandolins (Artistic Director Adrian Hooper) has made a major contribution to mandolin music in Australia and a significant amount of mandolin music was composed for this ensemble, and their lasting legacy is their extensive recordings of these works (over 115 CDs), which are still heard on ABC Classic FM radio today. Composers they have commissioned include Dr Eric Gross, Ann Carr-Boyd, Larry Sitsky, Caroline Szeto, Betty Beath, Ian Shanahan and John Peterson. In January 1979, the Federation of Australian Mandolin Ensembles (FAME) Inc. was formed. Bruce Morey from Melbourne is the first FAME President. Plans were made to send an Australian Mandolin Orchestra on a tour to Germany, which occurred May 1980.

In Australian country and folk, the mandolin is not unknown. Groups such as My Friend The Chocolate Cake use the mandolin extensively. The McClymonts also use the mandolin, as do the Blue Tongue Lizards. Nevertheless, in folk and traditional styles, the mandolin remains more popular in Irish Music and other traditional repertoires.

Brazil

The mandolin has a long and rich tradition in Brazilian folk music, especially in the style called choro. The composer and mandolin virtuoso Jacob do Bandolim did much to popularize the instrument through many recordings, and his influence continues to the present day. Some contemporary mandolin players in Brazil include Jacob's disciple Deo Rian, and Hamilton de Holanda (the former, a traditional choro-style player, the latter an eclectic innovator).

The mandolin came into Brazil by way of Portugal. Portuguese music has a long tradition of mandolins and mandolin-like instruments (see, for example, the Portuguese guitar).

The mandolin is used almost exclusively as a melody instrument in Brazilian folk music - the role of chordal accompaniment being taken over by the cavaco and nylon-strung guitar. Its popularity, therefore, has risen and fallen with instrumental folk music styles, especially choro. The later part of the 20th century saw a renaissance of choro in Brazil, and with it, a revival of the country's mandolinistic tradition.

Continental Europe

An increased interest in bluegrass music, especially in Central European countries such as the Czech Republic and Slovak Republic, has inspired many new mandolin players and builders. These players often mix traditional folk elements with bluegrass. Classically, Beethoven composed mandolin music[8] and enjoyed playing the mandolin.[9] The opera *Don Giovanni* by Mozart includes some mandolin parts. Also very well known are the mandolin concerti by Vivaldi. Some 20th century classical composers also used the mandolin as their instrument of choice (amongst these are: Schoenberg, Webern, Stravinsky, Zappa).

Greece

The mandolin has a long tradition in the Ionian islands (the *Heptanese*) and Crete. It has long been played in the Aegean islands outside of the control of the Ottoman Empire. It is common to see choirs accompanied by mandolin players (the *mandolinátes*) in the Ionian islands and especially in the cities of Corfu, Zakynthos, and Kefalonia. The evolution of the repertoire for choir and mandolins (*kantádes*) occurred during Venetian rule over the islands.

On the island of Crete, along with the lyra and the laouto (lute), the mandolin is one of the main instruments used in Cretan Music. It appeared on Crete around the time of the Venetian rule of the island. Different variants of the mandolin, such as the "mantola," were used to accompany the lyra, the violin, and the laouto. Stelios Foustalierakis reported that the mandolin and the *mpougari* were used to accompany the lyra in the beginning of the 20th century in the city of Rethimno. There are also reports that the mandolin was mostly a woman's musical instrument. Nowadays it is played mainly as a solo instrument in personal and family events on the Ionian islands and Crete.

India

Mandolin music was used in the Indian Movies as far back as the 1940s by the Raj Kapoor Studios in movies such as Barsaat, Awara etc. Adoption of the mandolin in Carnatic music is recent and, being essentially a very small electric guitar, the instrument itself bears rather small resemblance to European and American mandolins. U. Srinivas has, over the last couple of decades, made his version of the mandolin very popular in India and abroad. Many adaptations of the instrument have been done to cater to the special needs of Indian Carnatic music.

This type of mandolin is also used in Bhangra, dance music popular in Punjabi culture.

Ireland

The mandolin is becoming a somewhat more common instrument amongst Irish traditional musicians. Fiddle tunes are readily accessible to the mandolin player because of the equivalent range of the two instruments and the practically identical (allowing for the lack of frets on the fiddle) left hand fingerings.

Although almost any variety of acoustic mandolin might be adequate for Irish traditional music, virtually all Irish players prefer flat-backed instruments with oval sound holes to the Italian-style bowl-back mandolins or the carved-top mandolins with f-holes favoured by bluegrass mandolinists. The former are often too soft-toned to hold their own in a session (as well as having a tendency to not stay in place on the player's lap), whilst the latter tend to sound harsh and overbearing to the traditional ear. The f-hole mandolin, however, does come into its own in a traditional session, where its brighter tone cuts through the sonic clutter of a pub. Greatly preferred for formal performance and recording are flat-topped "Irish-style" mandolins (reminiscent of the WWI-era Martin Army-Navy mandolin) and carved (arch) top mandolins with oval soundholes, such as the Gibson A-style of the 1920s. Noteworthy Irish mandolinists include Andy Irvine (who almost always tunes the E down to D), Mick Moloney, Paul Kelly, and Claudine Langille. John Sheahan and Barney McKenna, fiddle player and tenor banjo player respectively, with The Dubliners are also accomplished Irish mandolin players. The Dubliners "Live at the Gaiety" DVD features an extensive mandolin duet of a three-tune "set," two hornpipes and a reel. The instruments used are flat-backed, oval hole examples as described above: in this case made by UK luthier Roger Bucknell of Fylde Guitars. The Irish guitarist Rory Gallagher often played the mandolin on stage, and he most famously used it in the

song "Going To My Hometown."

Japan

Instruments of the mandolin family are popular in Japan, particularly Neapolitan (round-back) style instruments. Morishige Takei (1890–1949), who studied Italian in Tokyo College of Language and was a member of the court of Emperor Hirohito, established the mandolin orchestra in the Italian style before World War II. The military government could not persecute Japanese mandolinists by the authority of Takei and Italy as the Axis. So the Japanese mandolin orchestras continued to perform old Italian works after World War II, and they are prosperous today. In addition, Jiro Nakano (1902–2000) arranged many of the Italian works for regular orchestras or winds composed before World War II as new repertoires for Japanese mandolin orchestras.

Original compositions for mandolin orchestras were more and more composed after World War II. Seiichi Suzuki (1901–1980) and Tadashi Hattori (1908–2008) composed music for early Kurosawa films and many symphonic works for mandolin orchestras. Hiroshi Ohguri (1918–1982) was influenced by Béla Bartók. Yasuo Kuwahara (1946–2003) used German techniques.

Japanese mandolin orchestras consist of up to 40 or 50 members, and often include wind or percussion instruments.

New Zealand

The Auckland Mandolinata mandolin orchestra was formed in 1969 by Doris Flameling (1932–2004). Soon after arriving from Holland with her family, Doris started teaching guitar and mandolin in West Auckland. In 1969, she formed a small ensemble for her pupils. This ensemble eventually developed into a full size mandolin orchestra, which survives today. Doris was the musical director and conductor of this orchestra for many years. The orchestra is currently led by Bryan Holden (conductor).

The early history of the mandolin in New Zealand is currently being researched by members of the Auckland Mandolinata.

Portugal

The bandolim (Portuguese for *mandolin*) was a favorite instrument within the Portuguese bourgeoisie of the 19th century, but its rapid spread took it to other places, joining other instruments. Today you can see mandolins as part of the traditional and folk culture of Portuguese singing groups and the majority of the mandolin scene in Portugal is in Madeira Island. Madeira has over 17 active mandolin Orchestras and Tunas. The mandolin virtuoso Fabio Machado is one of Portugal's most accomplished mandolin players. The Portuguese influence brought the mandolin to Brazil.

United Kingdom

The mandolin has been used extensively in the traditional music of England and Scotland for generations, but the instrument has also found its way into British rock music. The mandolin was used by Mike Oldfield (and introduced by Vivian Stanshall) on Oldfield's album *Tubular Bells.* It was used extensively by the British folk-rock band Lindisfarne, who featured two members on the instrument, Ray Jackson and Simon Cowe, and whose "Fog on the Tyne" was the biggest selling UK album of 1971-1972. The instrument was also used extensively in the UK folk revival of the 1960s and 1970s with bands such as Fairport Convention and Steeleye Span taking it on as the lead instrument in many of their songs. "Maggie May" by Rod Stewart, which hit No. 1 on both the British charts and the Billboard Hot 100, also featured Jackson's playing. It has also been used by other British rock musicians. Led Zeppelin's bassist John Paul Jones is an accomplished mandolin player and has recorded numerous songs on mandolin including "Going to California" and "That's the Way"; the mandolin part on "The Battle of Evermore" is played by Jimmy Page, who composed the song. Other Led Zeppelin songs featuring mandolin are "Hey Hey What Can I Do," and "Black Country Woman." Pete Townshend of The Who played mandolin on the track "Mike Post Theme," along with many other tracks on Endless Wire. McGuinness Flint, for whom Benny Gallagher played the

mandolin on their most successful single, "When I'm Dead And Gone," is another example. Gallagher was also briefly a member of Ronnie Lane's Slim Chance, and played mandolin on their hit "How Come." One of the more prominent early users of the mandolin in popular music were The Incredible String Band, in which Robin Williamson played the instrument extensively throughout the bands musical career. Ian Anderson of Jethro Tull is a highly accomplished mandolin player (beautiful track "Pussy Willow"), as is his guitarist Martin Barre. The popular song "Please Please Please Let Me Get What I Want" by The Smiths featured a mandolin solo played by Johnny Marr. More recently, the Glasgow-based band Sons and Daughters have featured the mandolin, as played by Ailidh Lennon, on tracks such as "Fight," "Start to End," and "Medicine." British folk-punk icons the Levellers also regularly use the mandolin in their songs. Current bands are also beginning to use the Mandolin and its unique sound - such as South London's Indigo Moss who use it throughout their recordings and live gigs. The mandolin has also featured in the playing of Matthew Bellamy in the rock band Muse. It also forms the basis of Paul McCartney's 2007 hit "Dance Tonight." That was not the first time a Beatle played a mandolin, however; that distinction goes to George Harrison on "Gone Troppo," the title cut from the 1982 album of the same name. The mandolin is taught in Lanarkshire by the Lanarkshire Guitar and Mandolin Association to over 100 people. Also more recently hard rock supergroup Them Crooked Vultures have been playing a song based primarily using a mandolin. This song was left off their recent debut album, and features former Led Zeppelin bassist John Paul Jones.

In the Classical style mandolin is not unknown. Performers such as Hugo D'Alton, Alison Stephens and Michael Hooper continue to play British composers such as Michael Finnissy, James Humberstone and Elspeth Brooke.

United States

The mandolin's popularity in the United States was spurred by the success of a group of touring young European musicians known as the Estudiantina Figaro, or in the United States, simply the "Spanish Students." The group landed in the U.S. on January 2, 1880 in New York City, and played in Boston and New York to wildly enthusiastic crowds. Ironically, this ensemble did not play mandolins but rather Bandurrias, which are also small, double-strung instruments that resemble the mandolin. The success of the Figaro Spanish Students spawned several groups who imitated their musical style and colorful costumes. In many cases, the players in these new musical ensembles were Italian-born Americans who had brought mandolins from their native land. Thus, the Spanish Student imitators did primarily play mandolins and helped to generate enormous public interest in an instrument previously relatively unknown in the United States.

Mandolins were a fad instrument from the turn of the 20th century to the mid-1920s. Instruments were marketed by teacher-dealers, much as the title character in the popular musical *The Music Man*. Often these teacher-dealers would conduct mandolin orchestras: groups of 4-50 musicians who would play various mandolin family instruments together. One musician and director who made his start with a mandolin orchestra was pioneer African-American composer James Reese Europe. The instrument was primarily used in an ensemble setting well into the 1930s, although the fad died out at the beginning of the 1930s; the famous Lloyd Loar Master Model from Gibson (1923) was designed to boost the flagging interest in mandolin ensembles, with little success. The true destiny of the "Loar" as the defining instrument of bluegrass music didn't appear until Bill Monroe purchased F-5 S/N 73987[10] in a Florida barbershop in 1943 and popularized it as his main instrument.

The mandolin orchestras never completely went away, however. In fact, along with all the other musical forms the mandolin is involved with, the mandolin ensemble (groups usually arranged like the string section of a modern symphony orchestra, with first mandolins, second mandolins, mandolas, mandocellos, mando-basses, and guitars, and sometimes supplemented by other instruments) continues to grow in popularity. Since the mid-nineties, several public-school mandolin-based guitar programs have blossomed around the country, including Fretworks Mandolin and Guitar Orchestra, the first of its kind. The national organization, Classical Mandolin Society of America represents these groups.

Single mandolins were first used in southern string band music in the 1930s, most notably by brother duets such as the sedate Blue Sky Boys (Bill Bolick and Earl Bolick) and the more hard-driving Monroe Brothers (Bill Monroe and Charlie Monroe). However, the mandolin's modern popularity in country music can be directly traced to one man: Bill Monroe, the father of bluegrass music. After the Monroe Brothers broke up in 1939, Bill Monroe formed his own group, after a brief time called the Blue Grass Boys, and completed the transition of mandolin styles from a "parlor" sound typical of brother duets to the modern "bluegrass" style. He joined the Grand Ole Opry in 1939 and its powerful clear-channel broadcast signal on WSM-AM spread his style throughout the South, directly inspiring many musicians to take up the mandolin. Monroe famously played Gibson F-5 mandolin, signed and dated July 9, 1923, by Lloyd Loar, chief acoustic engineer at Gibson. The F-5 has since become the most imitated tonally and aesthetically by modern builders. Monroe's style involved playing lead melodies in the style of a fiddler, and also a percussive chording sound referred to as "the chop" for the sound made by the quickly struck and muted strings. He also perfected a sparse, percussive blues style, especially up the neck in keys that had not been used much in country music, notably B and E. He emphasized a powerful, syncopated right hand at the expense of left-hand virtuosity. Monroe's most influential follower of the second generation is Frank Wakefield and nowadays Mike Compton of the Nashville Bluegrass Band and David Long, who often tour as a duet. Tiny Moore of the Texas Playboys developed an electric five-string mandolin and helped popularize the instrument in Western Swing music.[11]

The other major original bluegrass stylists, both emerging in the early 1950s and active still, are generally acknowledged to be Jesse McReynolds (of Jim and Jesse) who invented a syncopated banjo-roll style called crosspicking and Bobby Osborne of the Osborne Brothers, who is a master of clarity and sparkling single-note runs. Highly respected and influential modern bluegrass players include Herschel Sizemore, Doyle Lawson, and the multi-genre Sam Bush, who is equally at home with old-time fiddle tunes, rock, reggae, and jazz. Ronnie McCoury of the Del McCoury Band has won numerous awards for his Monroe-influenced playing. The late John Duffey of the original Country Gentlemen and later the Seldom Scene did much to popularize the bluegrass mandolin among folk and urban audiences, especially on the east coast and in the Washington, D.C. area.

Jethro Burns, best known as half of the comedy duo Homer and Jethro, was also the first important jazz mandolinist. Tiny Moore popularized the mandolin in Western swing music. He initially played an 8-string Gibson but switched after 1952 to a 5-string solidbody electric instrument built by Paul Bigsby. Modern players David Grisman, Sam Bush, and Mike Marshall, among others, have worked since the early 1970s to demonstrate the mandolin's versatility for all styles of music. Chris Thile of California is a well known player; the band Nickel Creek features his playing in its blend of traditional and pop styles. Most commonly associated with bluegrass, mandolin has been used a lot in country music over the years. Some well-known players include Marty Stuart and Vince Gill. Kristian Bush of the country band Sugarland plays the mandolin frequently, though only as a rhythm instrument.

The mandolin has been used occasionally in rock music, first appearing in the psychedelic era of the late 1960s. Levon Helm of The Band occasionally moved from his drum kit to play mandolin, most notably on "Rag Mama Rag," "Rockin' Chair," and "Evangeline." Ian Anderson of Jethro Tull played mandolin on "Fat Man," from their second album, *Stand Up*, and also occasionally on later releases. Rod Stewart's still-played 1971 #1 hit "Maggie May" features a significant mandolin riff in its motif. Ray Jackson of Lindisfarne played this, and also on "Mandolin Wind," although credited in the liner notes (written by Stewart) thusly: "The mandolin was played by the mandolin player in Lindisfarne. The name slips my mind." Released as the B side of "Reason To Believe," the unexpected success of this song led to Jackson's resentment over the lack of credit.[12] David Grisman played mandolin on two Grateful Dead songs on the *American Beauty* album, "Friend Of The Devil" and "Ripple," which became instant favorites among amateur pickers at jam sessions and campground gatherings. John Paul Jones and Jimmy Page both played mandolin on a few Led Zeppelin songs. Dash Croft of the Soft Rock duo Seals and Crofts extensively used mandolin in their repertoire during the 1970s.

Some rock musicians today use mandolins, typically single-stringed electric models rather than double-stringed acoustic mandolins. One example is Tim Brennan of the Irish-American punk rock band Dropkick Murphys. In

addition to electric guitar, bass, and drums, the band uses several instruments associated with traditional Celtic music, including mandolin, tin whistle, and Great Highland bagpipes. The band explains that these instruments accentuate the growling sound they favor. The 1991 R.E.M. hit "Losing My Religion" was driven by a few simple mandolin licks played by guitarist Peter Buck, who also played the mandolin in nearly a dozen other songs. The single peaked at #4 on the Billboard Hot 100 chart (#1 on the rock and alternative charts),[13] the highest ranking for a song featuring mandolin in twenty years. Jack White of The White Stripes played mandolin for the film *Cold Mountain,* and plays mandolin on the song "Little Ghost" on the White Stripes album *Get Behind Me Satan*; he also plays mandolin on "Prickly Thorn, But Sweetly Worn" on *Icky Thump*. David Immerglück of the Counting Crows, Monks of Doom, and Glider is also known to feature the mandolin in many of his recordings, especially those with the Counting Crows. Rock superstar Tommy Shaw of Styx has used the mandolin in the their international hit "Boat on the River" (1979) and on the Shaw/Blades album *Influence* in the song "Dance with Me." Luther Dickinson of North Mississippi Allstars and The Black Crowes has made frequent use of the mandolin, most notably on the Black Crowes song "Locust Street." Pop punk band Green Day has used a mandolin in several occasions, especially on their 2000 album, *Warning*. Boyd Tinsley, violin player of the Dave Matthews Band has been using an electric mandolin since 2005. Nancy Wilson, rhythm guitarist of Heart, uses a mandolin in Heart's song "Dream of the Archer" from the album *Little Queen*. as well as in Heart's cover of Led Zeppelin's song "The Battle of Evermore." "Show Me Heaven" by Maria McKee, the theme song to the film *Days of Thunder*, prominently features a mandolin. Michael Kang, formerly of The String Cheese Incident (a bluegrass/rock/jazz-fusion jam band from Colorado), plays an electric 5-string octave mandolin as his primary instrument.

Mandolin has also been used in blues music, most notably by Ry Cooder, who performed outstanding covers on his very first recordings, Yank Rachell, Johnny Young, Carl Martin, and Gerry Hundt. It saw some use in jug band music, since that craze began as the mandolin fad was waning, and there were plenty of instruments available at relatively low cost. Very rarely mandolins are played with bottlenecks or slides. Sam Bush plays with a slide, mostly on a four string mandolin.

Venezuela

As in Brazil, the Mandolin has played an important role in the Music of Venezuela. It has enjoyed a privileged position as the main melodic instrument in several different regions of the country. Specifically, the eastern states of Sucre, Nueva Esparta, Anzoategui and Monagas have made the mandolin the main instrument in their versions of Joropo together with Puntos, Jotas, Polos, Fulias, Merengues and Malagueñas. Also; in the west of the country the sound of the Mandolin is intrinsically associated with the regional genres of the Venezuelan Andes: Bambucos, Pasillos, Pasodobles, and Waltzes. In the western city of Maracaibo the Mandolin has been played in Decimas, Danzas and Contradanzas Zulianas as well as in the capital of the country Caracas; where the Merengue Rucaneao, Pasodobleas and Waltzes have been played with mandoline for almost a century. Today, the Mandoline in Venezuela have developed an important group of virtuoso players and ensembles such as Alberto Valderrama, Jesus Rengel, Ricardo Sandoval, Saul Vera, and Cristobal Soto.

References

[1] "Musical Instruments, A Comprehensive Dictionary," by Sibyl Marcuse (Corrected Edition 1975)
[2] "The New Grove Dictionary of Music and Musicians, Second Edition," edited by Stanley Sadie and others (2001)
[3] Embergher History (http://www.embergher.com/index.php?id=9)
[4] CIMCIM International Directory of Musical Instrument Collections (http://www.music.ed.ac.uk/euchmi/cimcim/id/index.html)
[5] *The Early Mandolin* by James Tyler and Paul Sparks (1989)
[6] *The Classical Mandolin* by Paul Sparks (1995)
[7] Recollections - by Phil Skinner. FIGA magazine Jan. Feb. 1981 (Fretted Instrument Guild of America)
[8] http://daniellarson.com/concerts/walz/walz_concert.htm
[9] http://www.mandozine.com/music/dawgtab/bthoven.php
[10] http://www.mandolinarchive.com/perl/show_mando.pl?55
[11] Tiny Moore (http://www.texasplayboys.net/Biographies/moore.htm)
[12] The Man With The World's Most-Heard Mandolin Solo - By Bill Graham - Special for the Mandolin Cafe (http://www.mandolincafe.com/news/publish/mandolins_00938.shtml)
[13] Billboard Hot 100 (http://www.billboard.com/#/song/r-e-m/losing-my-religion/2678446)

External links

- Accademia Mandolinistica Pugliese (Puglia-Italy) (http://www.accademiamandolinisticapugliese.it/)
- Mandolin (http://www.dmoz.org//Arts/Music/Instruments/Stringed/Mandolin//) at the Open Directory Project
- The Mandolin, The Serenade of Italy, podcast and slideshow (http://essenceofitaly.libsyn.com/index.php?post_id=322636)
- The Mandolin Tools, Freeware Windows application with chords and scales (http://www.maalflasken.dk/mandolintools/)
- Mandolin Cafe, a popular and eclectic website focusing on mandolin culture and community (http://www.mandolincafe.com)

Further reading

CHORD DICTIONARIES

- Richards, Tobe A. (2007). *The Mandolin Chord Bible: 2,736 Chords*. United Kingdom: Cabot Books. ISBN 978-1-906207-01-4. — A very comprehensive chord dictionary
- Major, James (2002). *Mandolin Chord Book*. United States: Music Sales Ltd. ISBN 978-0825622960. — A case-style chord dictionary
- Johnson, Chad (2003). *Hal Leonard Mandolin Chord Finder*. United States: Hal Leonard. ISBN 978-0634054228. — A comprehensive chord dictionary

METHOD & INSTRUCTIONAL GUIDES

- Bay, Mel (1987). *Complete Mandolin Method*. United States: Mel Bay. ISBN 978-0871667632. — Instructional guide

Ocarina

Ocarina

Classification	Wind, Woodwind, Aerophone
Related instruments	
Xun, Tin Whistle, Recorder, Flute	

The **ocarina** (/ɒkəˈriːnə/) is an ancient flute-like wind instrument.[1] Variations do exist, but a typical ocarina is an enclosed space with four to twelve finger holes and a mouthpiece that projects from the body. It is often ceramic, but other materials may also be used, such as plastic, wood, glass, clay, and metal.

History

Giuseppe Donati, Italian inventor of the modern ocarina, with his work.

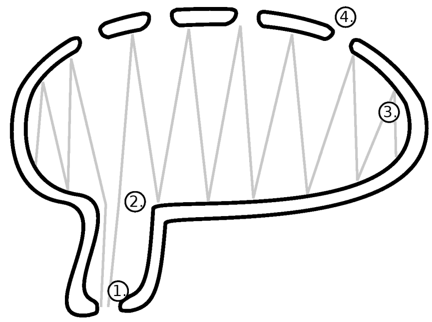
The ocarina belongs to a very old family of instruments, believed to date back to over 12,000 years.[2] Ocarina-type instruments have been of particular importance in Chinese and Mesoamerican cultures. For the Chinese, the instrument played an important role in their long history of song and dance. The ocarina has similar features to the Xun (塤), another important Chinese instrument (but is different in that Ocarina uses an internal duct, whereas Xun is blown across the outer edge.)[3] In Japan, the traditional ocarina is known as the *tsuchibue* (kanji: 土笛; literally "earthen flute"). Different expeditions to Mesoamerica, including the one conducted by Cortés, resulted in the introduction of the ocarina to the courts of Europe. Both the Mayans and Aztecs had produced versions of the ocarina, but it was the Aztecs who brought the song and dance to Europe that accompanied the ocarina. The ocarina went on to become popular in European communities as a toy instrument.[4] [5]

Its earliest use in Europe dates back to the 19th century in Budrio, a town near Bologna, Italy, where Giuseppe Donati transformed the ocarina from a toy, which only played a few notes, into a more comprehensive instrument (known as the first "classical" ocarinas). The word *ocarina* in the Bolognese dialect means "little goose." The earlier form was known in Europe as a gemshorn, which was made from animal horns of the Gemsbok.

The ocarina was featured in the Nintendo video game *The Legend of Zelda: Ocarina of Time*, attracting a marked increase in interest and a dramatic rise in sales.[6] [7]

Musical performance

Tone production/acoustics



How an ocarina works:

1. Air enters through the windway
2. Air strikes the labium, producing sound
3. Air vibrates throughout the inside of the ocarina
4. Covering and uncovering holes lowers and raises the pitch

The ocarina, unlike other vessel flutes, has the unusual quality of not relying on the pipe length to produce a particular tone. Instead the tone is dependent on the ratio of the total surface area of opened holes to the total cubic volume enclosed by the instrument. This means that, unlike a flute or recorder, sound is created by resonance of the entire cavity and the placement of the holes on an ocarina is largely irrelevant — their size is the most important factor. Instruments that have toneholes close to the voicing/embouchure should be avoided, however, because this weakens tonal production since an ocarina is a Helmholtz resonator.

The resonator in the ocarina can create overtones, but because of the common "egg" shape, these overtones are many octaves above the keynote scale.[8] In similar Helmholtz resonator instruments with a narrow cone shape, like the Gemshorn or Tonette, some partial overtones are available. The technique of overblowing to get a range of higher pitched notes is not possible with the ocarina because of its vessel shape, so the range of pitches available is limited to a 12th. Some Ocarina makers increase the range by designing double- or triple-chambered ocarinas tuned 1 octave apart although some double ocarinas are not made to increase the range, but to play in harmony with the other chambers. These double and triple ocarinas can also play chords.

Different notes are produced by covering the holes, and by opening and closing more or less of the total hole area. The tone is then produced through the sound hole/embouchure. The tone can also be varied by changing blowing strength to bend pitch.

Musical notation/tabulature

Ocarina music is written in three main ways. The most apparent is the use of sheet music. There are archives of sheet music either specifically written for ocarinas, or adapted from piano sheet music. Since some ocarinas are fully chromatic and can be played in professional musical situations, including classical and folk, sheet music is an ideal notation for ocarinas.

Second is the use of numerical tablature, which expresses the musical notes as numbers. Some makers have developed their own system of numerical tablature for their ocarinas, while others follow a more universal system where numbers correspond to different notes on the scale. This method is typically used by beginners who have not learned to read sheet music.

A third method uses a pictorial tablature similar to the ocarina's finger hole pattern, with blackened holes that represent which holes to cover. The tablature represents the holes on the top of the ocarina, and, where necessary, the holes on the underside. This enables easy playing, particularly for beginners. The two most popular tabulature systems are:

- The John Taylor four-hole system (invented in 1964 by British mathematician John Taylor)
- The 10 hole sweet potato system (invented by Giuseppe Donati of Budrio Italy)

Depending on the artist, some may write a number or figure over the picture to depict how many beats to hold the note.[9]

Types

There are many different styles of ocarinas varying in shape and the number of holes.

- Transverse (Sweet potato) - This is the best known style of ocarina. It has a rounded shape and is held with two hands horizontally. Depending on the number of holes, one just needs to open one more hole than the previous in order to ascend in pitch. The two most common Transverse ocarinas are the 10-holes (originated by Giuseppe Donati in Italy) and the 12-holes.
- Pendants: There are two types:
  - English Pendant - These are usually very small and very portable, and use an English fingering system (4–6 holes).
  - Peruvian Pendant - Dating from the time of the Incas, used as instruments for festivals, rituals and ceremonies. They are (usually the area occupied by them) today with designs of animals or simply oval (8–9 holes).
- Inline - These are often called a "fusion" of the Pendant and the Transverse. This style is known for being very small and compact, yet there are more holes than the pendant. This allows one to ascend in pitch with the linear finger pattern rather than finger combinations
- Multi chambered ocarinas - Better known as "Double" and "Triple" ocarinas, this type exists within the three broad categories of ocarina. These ocarinas overcome the disadvantage of ocarinas of having a limited range of notes. A Transverse Double ocarina typically plays 2 octaves + 2 notes, and a Transverse Triple ocarina plays with a range about 2 octaves + 7 notes. Double ocarinas for Pendant and Inline ocarinas also exist. Double Inline ocarinas are specially designed to be able to play chords, for harmonic playing.
- Ocarinas with keys have been produced by several makers, mostly experimentally, beginning in the late 19th century. Keys and slides may be added with the intention of either expanding the instrument's range, or to enable the fingers to reach holes that are widely spaced.

Similar instruments

Other vessel flutes include the Chinese xun and African globe flutes. The xun (simplified Chinese: 埙; traditional: 塤; pinyin: xūn) is a Chinese vessel flute made of clay or ceramic. It is one of the oldest Chinese instruments. Shaped like an egg, it differs from the ocarina in being side-blown, like the Western concert flute, rather than having a recorder-like mouthpiece (a fipple or beak). Similar instruments exist in Korea (the *hun*) and Japan (the *tsuchibue*).

A related family of instruments is the closed-pipe family, which includes the panpipes and other instruments that produce their tone by vibrating a column of air within a stopped cylinder.

The old fashioned jugband jug also has similar properties.

The traditional German instrument Gemshorn works nearly the same way as an ocarina. The only difference is the material it's made from: the horn of the chamois, goat, or other suitable animal.

Borrindo is a simple hollow clay ball with three to four holes, one somewhat larger and other smaller and of the same size. The holes are arranged in an isosceles triangular form. The borrindo is made out of soft alluvial clay available in plenty everywhere in the central Indus Valley. Being of the simplest make, it is made even by children. Some adults make fine borrindos of larger size, put pottery design on them, and bake them. These baked borrindos with pottery design are the later evolved forms of this musical instrument, which appears to have been used in its simple unbaked form since times immemorial. The sound notes are produced by blowing somewhat horizontally into the larger hole. Finger tips are placed on smaller holes to regulate the notes. Its ease of play makes it popular among children and the youth.

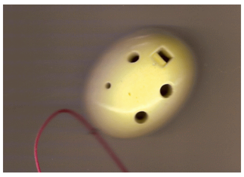
Gallery

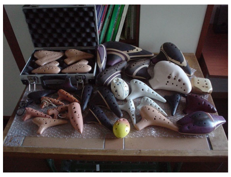

A triple chambered ocarina in the bass register.


An Asian double chambered ocarina. The two blow holes in the mouthpiece are clearly visible, which makes it possible for the player to play an extended range of notes (17 in total, in this case from A4 to C6).


Meissen "Blue Onion" pattern porcelain transverse ocarina, early 20th Century.

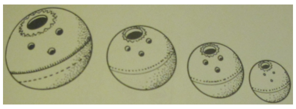

Front and back view of transverse ocarinas. The double holes on front indicate a fingering system developed in 20th Century Japan.


The English pendant ocarina, invented in the 1960s by John Taylor, produces an entire octave using just four finger holes.


Ocarinas owned by a professional ocarinist.


Novelty ocarina - ocarina in the shape of a teacup.


A transverse ocarina.


A Sindhi Borrindo, a form of Ocarina produced in different sizes to give different tones.The borrindo is made out of soft alluvial clay available in plenty everywhere in the central Indus Valley.

References

[1] "History of Ocarina" (http://www.ocarina-vale.com/History2.html). www.ocarina-vale.com. . Retrieved 2007-04-21.
[2] "Ocarina" (http://www.music.vt.edu/musicdictionary/texto/Ocarina.html). Virginia Tech Multimedia Music Dictionary. . Retrieved 2007-04-21.
[3] "History of the Ocarina" (http://www.stlocarina.com/ocarina-history.html). STL Ocarina. . Retrieved 2007-04-21.
[4] "History of the Ocarina" (http://www.songbirdocarina.com). Song Bird Ocarina. . Retrieved 2007-04-21.
[5] "A Brief History" (http://www.terryrileyvesselflutes.com/a_brief_history.htm). Terry Riley Vessel Flutes. . Retrieved 2007-04-21.
[6] King, Sharon R. (1999-02-15). "Compressed Data; Can You Play 'Feelings' On the Ocarina?" (http://www.nytimes.com/1999/02/15/business/compressed-data-can-you-play-feelings-on-the-ocarina.html). *New York Times*. . Retrieved 7 December 2009.
[7] "Own the Ocarina of Time" (http://gear.ign.com/articles/927/927008p1.html). IGN. 2008-11-04. . Retrieved 7 December 2009.
[8] *Fundamentals of Musical Acoustics*. Arthur H. Benade pp.473–476
[9] "Ocarina Fingering Charts" (http://hindocarina.com/enjoy/fingering.shtml). www.hindocarina.com. . Retrieved 2007-04-21.

External links

- Ocarinas at the whistle museum (http://whistlemuseum.com/2010/06/26/pre-columbian-whistles.aspx/pre-Columbian)
- Ocarina Instrument (http://www.ocarinainstrument.com)

Rhodes piano

The **Rhodes piano** is an electro-mechanical piano, invented by Harold Rhodes[1] during the fifties and later manufactured in a number of models, first in collaboration with Fender and after 1965 by CBS.

Rhodes Mark II 73 Stage Piano

As a member of the electrophone sub-group of percussion instruments, it employs a piano-like keyboard with hammers that hit small metal tines, amplified by electromagnetic pickups.[1] A 2001 New York Times article described the instrument as "a pianistic counterpart to the electric guitar"[2] having a "shimmering, ethereal sound."[2]

The Rhodes piano enjoyed a resurgence of popularity beginning in the 1990s[2] — with contemporary artists highlighting the instrument, including Portishead, D'Angelo, Erykah Badu,[2] Chick Corea, Jamiroquai, Herbie Hancock, Steely Dan and Stevie Wonder.

In the late 1960s, along with other electric pianos from Wurlitzer and Baldwin, the Rhodes piano had allowed music classes to incorporate the piano for the first time — with earphones enabling multiple students in the same room to effectively learn the instrument without disturbing each other.[3]

The last model, the MkV, was released in 1984, when the factory in Fullerton was closed. Rhodes Music Corporation re-introduced the instrument in 2007.[4]

History

WWII: The *Army Air Corps piano*[1] was an acoustic instrument invented by Harold Rhodes during World War II in an effort to create a piano that injured soldiers could play while lying in a hospital bed. Rhodes built the first model in 1942,[1] a 29-note keyboard using aluminum tubing from a B-17 bomber aircraft.[1]

> During World War II (after the battle of the Bulge), the Air Surgeon General asked Rhodes, by now America's most popular piano teacher, to devise a musical therapy program for convalescing GI's. At a loss to know where to get enough pianos, Rhodes hit upon the brilliant idea of using Air-Force surplus parts from U.S. bombers to make miniature "lap-top" piano kits the troops could build for themselves.[5]

Rhodes Pre-Piano

Rhodes PianoBass

Rhodes Mark II 73 Stage

Rhodes Mark 7 on stage

The Air Force asked Rhodes to write a training manual and draw blueprints of what came to be known as the *Army Air Corps piano*,[1] so soldiers could make their own. Also called a "Xylette," thousands of the rudimentary models were built.[6]

1946-1965: Harold Rhodes subsequently founded *The Rhodes Piano Corporation* and introduced the Pre-Piano at NAMM 1946. In 1959, Rhodes entered a joint venture with Leo Fender to manufacture the instruments under a company named *Fender & Rhodes*. The partnership lasted for six years with the model marketed as the *Fender Rhodes Piano Bass*, a 32-note version with only the low range of the piano, accounting for the bulk of the sales. The Fender Rhodes *Celeste* was a similar keyboard covering the midrange of the piano, and electric pianos with tube amplifiers were prototyped at the time. The *Piano 73* would become known as the *Fender Rhodes Electric Piano*, with an amplifier cabinet used as a base for supporting the piano keyboard.[6]

1965-1984: CBS purchased the Fender company in 1965,[7] and offered Rhodes a release from his Fender agreement.[6] Rhodes stayed with CBS,[6] with the company first offering the full 73-note *Suitcase* model, in addition to the Piano Bass and the Celeste. In 1969 the 73-note *Mark I Stage Piano* was introduced as a one-piece alternative to the Suitcase style, featuring 4 detachable legs (used in Fender steel pedal guitars), a sustain pedal with an adjustable *pushrod* (the main component in a Rogers hi-hat) and a single output (mislabeled *INPUT*) for use with an outboard guitar cabinet or other source of amplification. The Fender Twin Reverb was the amplifier shown in catalogs as the cabinet of choice for the Stage Piano, and many Rhodes players rely on that particular 2 x 12" tube amp to get the classic tone. 1970 saw the release of an 88-key Suitcase Piano, and improvements in both the piano

action and tone generator life were made a priority. In 1975 the decision was made to drop *Fender* from the name[6] for marketing purposes. Production in the 16-year *CBS period* reached as high as 50 units per day around 1978-79,[6] but sales declined as 1980 approached, and the *Mark II Stage Piano* was introduced in an attempt to revitalize the product. Production ended in 1984, with the *Rhodes Mark V* being the final CBS model.[6] Harold Rhodes estimated that approximately 250,000 pianos were produced in total by the time CBS Musical Instruments ceased production.

1987-1991: Roland acquired the Rhodes trademark from CBS for $20,000 in 1987. They manufactured only two digital piano model, MK-80 (88key) and MK-60 (64key), using S/A Synthesis method and weighted action, but the sound of the Roland piano disgusted Harold Rhodes.[6]

1997: Harold Rhodes re-acquired the Rhodes trademark to re-issue the original mechanical Rhodes piano, but he died in December 2000.[6]

2007: In 2007, a re-formed Rhodes Music Corporation introduced a reproduction of the original electric piano called the Rhodes Mark 7. This was a version of the Rhodes housed in a molded plastic housing, most similar to the CBS Rhodes Mark V in terms of style and mechanics. Total sales of this specific piano have not been disclosed.[4]

Models

The first Fender Rhodes product was the **Fender Rhodes Piano Bass**, a 32-key model. No other models were mass-produced until after the CBS takeover of Fender in 1965. Shortly afterwards the **73-key Fender Rhodes Electric Piano** went into production.

Fender Rhodes Piano Bass
(1960, Fiesta Red finish)

Fender Rhodes Piano 73
(1965, Silver Top)

The '60s also saw the **Fender Rhodes Celeste**, the Student/Instructor models and systems as well as the very rare Domestic models. In 1970 the more portable **Mk I Stage** model was added to the range as well as the two **88-key Stage** and **Suitcase** models. The Suitcase models included a built in pre-amp with the famous Stereo-Vibrato, plus a cabinet with stereo amplifier and speakers. In 1980, a **54-key Stage** model was also produced.

Fender Rhodes Mark I 88 Stage (1969)

Rhodes Mark I 73 Stage (1970)

Rhodes Mark I 88 Suitcase (1972)

The Rhodes went through continuous internal improvements: the hammers became all plastic, the pedestals changed shape (and were bare for a short while, the felt was on the underside of the hammer), the pickups were altered, and the tine structure modified to endure more wear. The **Mk II** model was introduced in late 1979.

Also manufactured for a brief period was the **Rhodes Mk III EK-10** which had analog oscillators and filters alongside the existing electromechanical elements. The overall effect was that of a Rhodes piano and a synthesizer being played simultaneously. Compared with the new polyphonic synthesizers being marketed at the same time it was limited in scope and sound, and very few units were sold.

The final classic Rhodes was the **Mk V**, introduced in 1984. Among other improvements, it had a lighter body and all new action with an improved cam, increasing the hammer stroke by 23%. With competition from digital and polyphonic synthesizers and the introduction of MIDI, production of Rhodes instruments ended in late 1984.

Rhodes Mark II (1979, bottom)

Rhodes Mark III (1980)

Rhodes Mark V (1984)

Rhodes Mark 7 (2007, rear)

A new **Rhodes Mark 7** was introduced at NAMM 2007 and Musik Messe 2007, featuring the same electromechanical design as the original instrument, but with a new futuristic look and number of changes.[8]

Sound-producing mechanism

Tuning forks of Fender Rhodes Mk I

The Rhodes piano's tone-generating principles are derived from the concept of an asymmetrical tuning fork, with a stiff wire (called a "tine"), struck by a felt-tipped (neoprene rubber-tipped after 1970) hammer, acting as one side of the tuning fork, and a counterbalancing resonating tone bar above the tine acting as the other side. This tone generator kit's vibrations are then picked up by an electromagnetic pickup (one for each tine), and amplified. The pickups' output is fed through a volume and a tone potentiometer on the namerail, and then to an output for external amplification.

The sound produced has a bell-like character not unlike a vibraphone, celesta or glockenspiel. Because the instrument produces sound electrically, the signal can be processed to yield many different timbral colors. On the Suitcase model the signal is processed through a "StereoVibrato", a low-frequency pan oscillation (actually a tremolo, but Leo Fender insisted on calling it vibrato, like on his amplifiers) effects unit, which pans the signal back and forth between right and left channels. It is this "rounded" or chiming sound that is called the classic Rhodes sound, which can be heard on, for example, many of Stevie Wonder's or Herbie Hancock's songs. This "chiming sound" is, as an example, used in the Radiohead song "Subterranean Homesick Alien" from the album OK Computer. The preamp with vibrato was included on the original Fender Rhodes Electric Pianos and after 1970 (with stereo panning) on the "suitcase" models; the "stage" models lack the preamp and the amplified speaker cabinet, but can be retrofitted.

Rhodes with Dyno modification (bottom)

During the 1980s a set of Rhodes modifications done by a company called "Dyno My Piano" became popular, inspired by one particular and very famous rental piano in L.A., the E-Rhodes, which can be heard on many records from that time. The modifications made the sound brighter, harder, and more bell-like, bringing out more of the attack in the Rhodes sound and making it cut through a mix like a grand piano. For instance, when notes are played forcefully, the sound becomes less sweet, as nonlinear distortion creates a characteristic "growling" or "snarling", called "bark" by pianists. Skilled players can

contrast the sweet and rough sounds to create an extremely expressive performance. This sound was emulated by the Yamaha DX7 with a patch that was enormously popular during the 80's (see DX7 Rhodes). Rhodes pianos have been used by indie music artists such as Warm Ghost[9] and BOBBY[10] to achieve "layered electronic effects".

References

[1] "Harold Rhodes, 89, Inventor of an Electronic Piano" (http://www.nytimes.com/2001/01/04/arts/harold-rhodes-89-inventor-of-an-electronic-piano.html?scp=1&sq=fender rhodes&st=cse). The New York Times, Jon Pareles, January 4, 2001. January 4, 2001. .

[2] "MUSIC; A 70's Castoff Returns to the Bandstand" (http://www.nytimes.com/2001/07/22/arts/music-a-70-s-castoff-returns-to-the-bandstand.html?scp=4&sq=fender rhodes&st=cse). The New York Times, David R. Adler, July 22, 2001. July 22, 2001. . Retrieved May 22, 2010.

[3] "Instruments: Turning On Students" (http://www.time.com/time/magazine/article/0,9171,839594,00.html). Time Magazine, Nov 1, 1968. November 1, 1968. . Retrieved May 22, 2010.

[4] "Rhodes Reborn Just In Time For Winter [[NAMM (http://www.gearwire.com/rhodes-returns.html)] '07"]. Gearwire.com, January 08, 2007. .

[5] "Rhodes Music Corporation: History" (http://www.rhodespiano.com/history.htm). Rhodes Music Corporation, Rhodespiano.com, History. .

[6] "The Rhodes Super Site" (http://www.fenderrhodes.com). James Garfield & Frederik Adlers. .

[7] Day, Paul (1979). *The Burns Book*. pp Publishing. pp. 36.

[8] "Rhodes Mark 7" (http://www.rhodespiano.com/). Rhodes Music Corporation. . Retrieved 2009-04-13.

[9] Peter Funk (19 January 2006). "Paul Duncan: Be Careful What You Call Home" (http://www.popmatters.com/pm/review/duncanpaul-becareful). *PopMatters*. . Retrieved 2011-05-08.

[10] "BOBBY" (http://jazner.com/?tag=partisan-records). *Jazner*. March 28th, 2011. . Retrieved 2011-05-24. "Sore Spores"

External links

- The Rhodes Super Site (http://www.fenderrhodes.com) – The dedicated website since 1996.
- Rhodes Music Corporation (http://www.rhodespiano.com) - The new Mark 7 manufacturer's website.
- Video highlighting the Rhodes Piano sound (http://www.youtube.com/watch?v=FYGDAspkXIY)

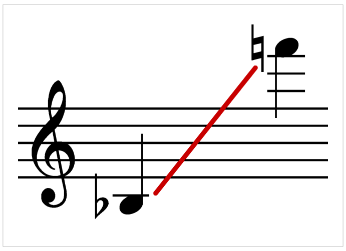
Saxophone

Saxophone

An alto saxophone in E♭

Classification	Wind Woodwind Aerophone
Hornbostel-Sachs classification	422.212-71 (Single-reeded aerophone with keys)
Inventor(s)	Adolphe Sax
Developed	28th June 1846[1]

Playing range



Related instruments

Military band family:

- Sopranino saxophone
- Soprano saxophone
- Alto saxophone
- Tenor saxophone
- Baritone saxophone
- Bass saxophone
- Contrabass saxophone
- Subcontrabass saxophone

Orchestral family:

- C soprano saxophone
- Mezzo-soprano saxophone
- C melody saxophone

Other saxophones:

- Sopranissimo saxophone ('Soprillo')
- Tubax

Musicians

• List of saxophonists

The **saxophone** (also referred to as the **sax**) is a conical-bore transposing musical instrument that is a member of the woodwind family. Saxophones are usually made of brass and played with a single-reed mouthpiece similar to that of the clarinet. The saxophone was invented by the Belgian clarinetist Adolphe Sax in 1846. He wanted to create an instrument that would both be the most powerful and vocal of the woodwinds and the most adaptive of the brass, which would fill the then vacant middle ground between the two sections. He patented the sax on June 28, 1846 in two groups of seven instruments each. Each series consisted of instruments of various sizes in alternating transposition. The series pitched in B♭ and E♭, designed for military bands, has proved extremely popular and most saxophones encountered today are from this series. A few saxophones remain from the less popular orchestral series pitched in C and F. These instruments never gained a foothold in the orchestral world. Although the C-melody was quite popular in the late 1920s and early 30s as a parlor instrument, it never gained a legitimate standing. Instruments keyed in F are rare.

While proving very popular in military band music, the saxophone is most commonly associated with jazz and classical music. There is substantial repertoire of concert music in the classical idiom for the members of the saxophone family. Saxophone players are called *saxophonists*.

History

Adolphe Sax, the inventor of the saxophone

The saxophone was developed in 1846 by Adolphe Sax, a Belgian-born instrument-maker, flautist, and clarinetist working in Paris. While still working at his father's instrument shop in Brussels, Sax began developing an instrument which had the projection of a brass instrument with the agility of a woodwind. Another priority was to invent an instrument which would overblow at the octave, unlike the clarinet, which rises in pitch by a twelfth when overblown; an instrument which overblew at the octave would have identical fingering for both registers.

Prior to his work on the saxophone, Sax made several improvements to the bass clarinet by improving its keywork and acoustics and extending its lower range. Sax was also a maker of the then-popular ophicleide, a large conical brass instrument in the bass register with keys similar to a woodwind instrument. His experience with these two instruments allowed him to develop the skills and technologies needed to make the first saxophones. Adolphe Sax created an instrument with a single reed mouthpiece like a clarinet, conical brass body like an ophicleide, and the acoustic properties of both the French horn and the clarinet.

Having constructed saxophones in several sizes in the early 1840s, Sax applied for, and received, a 15-year patent for the instrument on June 28, 1846.[2] The patent encompassed 14 versions of the fundamental design, split into two categories of seven instruments each and ranging from sopranino to contrabass. Although the instruments transposed at either F or C have been considered "orchestral", there is no evidence that Sax intended this. As only 3% of Sax's surviving production were pitched in F and C, and as contemporary composers used the E♭ alto and B♭ bass saxophone freely in orchestral music, it is almost certain that Sax experimented to find the most suitable keys for these instruments, settling upon instruments alternating between E♭ and B♭ rather than those pitched in F and C, for reasons of tone and economy (the saxophones were the most expensive wind musical instruments of their day). The C soprano saxophone was the only instrument to sound at concert pitch. All the instruments were given an initial written range from the B below the treble staff to the F three ledger lines above it, giving each saxophone a range of two and a half octaves.

Sax's patent expired in 1866;[3] thereafter numerous saxophonists and instrument manufacturers implemented their own improvements to the design and keywork. The first substantial modification was by a French manufacturer who extended the bell slightly and added an extra key to extend the range downwards by one semitone to B♭. It is suspected that Sax himself may have attempted this modification. This extension was adopted into almost all modern designs.

Bill Clinton plays the saxophone he received as a gift from Boris Yeltsin at a dinner party in 1994

Sax's original keywork, which was based on the Triebert system 3 oboe for the left hand and the Boehm clarinet for the right, was very simplistic and made playing some legato passages and wide intervals extremely difficult to finger, so numerous developers added extra keys and alternate fingerings to make chromatic playing less difficult. While the early saxophone had two separate octave vents to assist in the playing of the upper registers just as modern instruments do, players of Sax's original design had to operate these via two separate octave keys operated by the left thumb. A substantial advancement in saxophone keywork was the development of a method by which both tone holes are operated by a single octave key by the left thumb which is now universal on all modern saxophones. One of the most radical, however temporary, revisions of saxophone keywork was made in the 1950s by M. Houvenaghel of Paris, who completely redeveloped the mechanics of the system to allow a number of notes (C♯, B, A, G, F and E♭) to be flattened by a semitone simply by lowering the right middle finger. This enables a chromatic scale to be played over two octaves simply by playing the diatonic scale combined with alternately raising and lowering this one digit.[4] However, this keywork never gained much popularity, and is no longer in use.

Description

From left to right, an E♭ alto saxophone, a curved B♭ soprano saxophone, and a B♭ tenor saxophone

The saxophone consists of an approximately conical tube of thin metal, most commonly brass and sometimes plated with silver, gold, and nickel, flared at the tip to form a bell. At intervals along the tube are between 20 and 23 tone holes of varying size, including two very small 'speaker' holes to assist the playing of the upper register. These holes are covered by keys (also known as pad cups), containing soft leather pads, which are closed to produce an airtight seal; at rest some of the holes stand open and others are closed. The keys are controlled by buttons pressed by the fingers, while the right thumb sits under a thumb rest to help keep the saxophone balanced. The fingering for the saxophone is a combination of that of the oboe with the Boehm system, and is very similar to the flute or the upper register of the clarinet. Instruments that play to low A have a left thumb key for that note.

The simplest design of saxophone is a straight conical tube, and the sopranino and soprano saxophones are usually of this straight design. However, as the lower-pitched instruments would be unacceptably long if straight, for ergonomic reasons, the larger instruments usually incorporate a U-bend at, or slightly above, the third-lowest tone hole. As this would cause the bell of the instrument to point almost directly upward, the end of the instrument is either beveled or tilted slightly forward. This U-shape has become an iconic feature of the saxophone family, to the extent that soprano and even sopranino saxes are sometimes made in the curved style, even though not strictly necessary. By contrast, tenors and even baritones have occasionally been made in the straight style.[5] [6] Most commonly, however, the alto and tenor

saxophones incorporate a curved 'crook' above the highest tone hole but below the top speaker hole, tilting the mouthpiece through 90 degrees; the baritone, bass and contrabass extend the length of the bore by triple-folding this section.

Materials

A straight-necked Conn C melody saxophone (Conn New Wonder Series 1) with a serial number which dates manufacture to 1922

Most saxophones, both past and present, are made from brass. Despite this, they are categorized as woodwind instruments rather than brass, as the sound waves are produced by an oscillating reed, not the player's lips against a mouthpiece as in a brass instrument, and because different pitches are produced by opening and closing keys. The screw pins that connect the rods to the posts, as well as the needle and leaf springs that cause the keys to return to their rest position after being released, are generally made of blued or stainless steel. Since 1920, most saxophones have 'key touches' (smooth decorative pieces placed where the fingers touch the instrument) made from either plastic or mother of pearl.

Vintage silver-plated 'Pennsylvania Special' alto saxophone, manufactured by Julius Keilwerth[7] in Czechoslovakia, circa 1930

Other materials have been tried with varying degrees of success, such as the 1950s Grafton plastic alto saxophone. A few companies, such as Yanagisawa[13] and Bauhaus Walstein [9], have made some saxophone models from phosphor bronze because of its slightly different tonal qualities.[14] For example, although their designs are identical apart from the metal used, the bronze Yanagisawa A992[15] saxophones are said to sound "darker" than the brass versions. Yanagisawa and other manufacturers, starting with the King Super 20 around 1950, have made saxophone necks, bells, or entire instruments from sterling silver.[16] Keilwerth and P. Mauriat have made saxes with a nickel silver body like that of a flute.[17] [18] The effect of material on sound is controversial among sax players, and little solid research has been published.

After completing the instrument, manufacturers usually apply a thin coating of clear or colored acrylic lacquer, or silver plate, over the bare brass. The lacquer or plating serves to protect the brass from oxidation, and maintains its shiny appearance. Several different types and colors of surface finish have been used over the years.[19] It is also possible to plate the instrument with nickel or gold, and a number of gold-plated saxophones have been produced.[19] Plating saxophones with gold is an expensive process because gold does not adhere directly to brass. As a result, the brass is first plated with silver, then gold.

Some argue that the type of lacquer or plating, or absence thereof, may enhance an instrument's tone quality. The possible effects of different finishes on tone is a hotly debated topic, not least because other variables may affect an instrument's tone colors e.g. mouthpiece design and physical characteristics of the player. In any case, what constitutes a pleasing tone is a matter of personal preference.[20] [21]

Conn 6M "Lady Face"[8] brass alto saxophone (dated 1935) in its original case

1950s Grafton alto made of plastic

Yamaha YAS-25 alto saxophone. Circa 1990s

Yanagisawa A9932J alto saxophone: has a solid silver bell and neck with solid phosphor bronze body. The bell, neck and key-cups are extensively engraved. Manufactured in 2008

Bauhaus Walstein [9][10] [11] [12] tenor saxophone manufactured in 2008 from phosphor bronze

The lower portion of a P. Mauriat alto saxophone, showing the mother of pearl key touches and engraved brass pad cups

A Yamaha baritone saxophone

Mouthpiece and reed

Two mouthpieces for tenor saxophone: the one on the left is rubber; the one on the right is metal.

The saxophone uses a single-reed mouthpiece similar to that of the clarinet. Most saxophonists use reeds made from *Arundo donax* cane, but since the 20th century some have also been made of fiberglass and other composite materials. Reeds made from composite materials are more durable, but generally produce a brighter tone with a timbre that is noticeably different from reeds made from cane, and are, therefore, generally considered to produce tone that is less desirable than the tone produced from a cane reed. The saxophone mouthpiece is larger than that of the clarinet, has a wider inner chamber, and lacks the cork-covered tenon of a clarinet mouthpiece because the saxophone neck inserts into the mouthpiece whereas the clarinet mouthpiece piece is inserted into the barrel. The most important difference between a saxophone embouchure and a clarinet embouchure is that the saxophone mouthpiece should enter the mouth at a much lower or flatter angle than the clarinet. The embouchure for clarinet must also be more firm than that for saxophone. The muscles in the lip and jaw will develop naturally the more one plays, and the "long tones" exercise helps a great deal with this aspect of playing.[22] Mouthpieces come in a wide variety of materials, including vulcanized rubber (sometimes called rod rubber or ebonite), plastic, and metals such as bronze or surgical steel. Less common materials that have been used include wood, glass, crystal, porcelain, and even bone. According to Larry Teal, the mouthpiece material has little, if any, effect on the sound, and the physical dimensions give a mouthpiece its tone colour;[23] Mouthpieces with a concave ("excavated") chamber are more true to Adolphe Sax's original design; these provide a softer or less piercing tone, and are favored by some saxophonists, including students of Sigurd Raschèr, for classical playing. Conversely, mouthpieces with a smaller chamber or lower clearance above the reed, called high baffle, produce a brighter sound with maximum projection and are favored by many jazz and funk players. Most skilled saxophonists settle on a mouthpiece somewhere between these extremes regardless of their primary idiom and most that play both jazz and classical music have different equipment for each.

Like clarinets, saxophones use a single reed. Saxophone reeds are proportioned slightly differently to clarinet reeds, being wider for the same length, although some soprano saxophonists will use clarinet reeds on the soprano saxophone. Each size of saxophone (alto, tenor, etc.) uses a different size of reed. Reeds are commercially available in a vast array of brands, styles, and strengths. Each player experiments with reeds of different strength (hardnesses) and material to find which strength and cut suits his or her mouthpiece, embouchure, tendencies, and playing style.

Cases

Saxophone instrument cases serve as essential protection and covering for saxophones during transportation and/or storage. Some cases provide protection from weather changes or environments that may be hazardous to the instrument. Usually, purchased saxophones come with factory cases that are manufactured or distributed by the saxophone company. There are also companies, such as Pro Tec, that offer traveling cases that are light weight, durable, and economically efficient. This especially matters when traveling with larger instruments such as the baritone saxophone. Some saxophone case providers would be Pro Tec, Bam, SKB, Reunion Blues, Gator, etc.

Uses

The saxophone first gained popularity in the niche it was designed for: the military band. Although the instrument was studiously ignored in Germany, French and Belgian military bands took full advantage of the instrument that Sax had designed specifically for them. Most French and Belgian military bands incorporate at least a quartet of saxophones comprising at least the E♭ baritone, B♭ tenor, E♭ alto and B♭ soprano. These four instruments have proved the most popular of all of Sax's creations, with the E♭ contrabass and B♭ bass usually considered impractically large and the E♭ sopranino insufficiently powerful. British military bands tend to include at minimum two saxophonists on the alto and tenor.

The saxophone has more recently found a niche in both concert band and big band music, which often calls for the E♭ baritone, B♭ tenor and E♭ alto. The B♭ soprano is also occasionally utilised, in which case it will normally be played by the first alto saxophonist. The bass saxophone in B♭ is called for in band music (especially music by Percy Grainger) and big band orchestrations, especially music performed by the Stan Kenton "Mellophonium Orchestra". In the 1920s the bass saxophone was used often in classic jazz recordings, since at that time it was easier to record than a tuba or double bass. It is also used in the original score (and movie) of Leonard Bernstein's *West Side Story*.

The saxophone has been more recently introduced into the symphony orchestra, where it has found increased popularity. In one or other size, the instrument has been found a useful accompaniment to genres as wide-ranging as opera, choral music and chamber pieces. Many musical scores include parts for the saxophone, usually either doubling another woodwind or brass instrument. In this way the sax serves as a middle point between woodwinds and brass, helping to blend the two sections

Ensembles

A saxophonist in a military band, carrying a baritone saxophone

By far, the most well-known implementation of the saxophone is modern jazz music. This is usually as a solo instrument with a rhythm section, but sometimes in the form of a saxophone quartet or big band.

The saxophone quartet is usually made up of one B♭ soprano, one E♭ alto, one B♭ tenor and one E♭ baritone (SATB). On occasion, the soprano is replaced with a second alto sax (AATB); a few professional saxophone quartets have featured non-standard instrumentation, such as James Fei's Alto Quartet[24] (four altos) and Hamiet Bluiett's Bluiett Baritone Nation (four baritones).

There is a repertoire of classical compositions and arrangements for the SATB instrumentation dating back to the nineteenth century, particularly by French composers who knew Adolphe Sax. A list of well known current saxophone quartets includes the Amherst,[25] Amstel, Anubis, Aurelia,[26] Prism, H2, Habanara, Hanumi, Mana, Raschèr,[27] Rova, and Zzyzx Quartets. Historically, the quartets led by Marcel Mule and Daniel Deffayet, saxophone professors at the Conservatoire de Paris, were started in 1928 and 1953, respectively, and were highly regarded. The Mule quartet is often considered to be the prototype for all future quartets due the level of virtuosity demonstrated by its members and its central role in the development of the quartet repertoire. However organised quartets did exist before Mule's ensemble, the prime example being the quartet headed by Eduard Lefebre (1834–1911), former soloist with the Sousa band, in the United States *c*1904-1911. Other ensembles most likely existed at this time as part of the saxophone sections of the many touring "business" bands that existed in the late 19th and early 20th centuries. More recently, the World Saxophone Quartet has become known as the preeminent jazz saxophone quartet. The Rova Saxophone Quartet, based in San Francisco, is noted for its work in the fields of contemporary classical music and improvised music.

There are a few larger all-saxophone ensembles, the most prominent including the 9-member SaxAssault,[28] and Urban Sax, which includes as many as 52 saxophonists. The 6-member Nuclear Whales Saxophone Orchestra owns one of the few E♭ contrabass saxophones, and plays a variety of ensemble pieces including "Casbah Shuffle", a duet for sopranino and contrabass.[29] Very large groups, featuring over 100 saxophones, are sometimes organized as a novelty at saxophone conventions.[30]

Studio saxophone players and ensembles have also been a major influence on the history of music. Although they are not usually full members of a band, they can be a vital part in the overall sound of a music set. In recent years, there has also been an increasing number of saxophone players in studio bands, in the vein of '70s bands such as Pink Floyd and Yes.

Tenor saxophonist Bobby Rogers, mentor to Kenny G and studio saxophone player for Metallica Inc.

Miscellaneous saxophones and related instruments

Straight saxophones, including some unusual variants. Clockwise from top left: an E♭ baritone, a B♭ tenor, a C soprano, a B♭ soprano, and a B♭ soprillo

A number of saxes and saxophone-related instruments have appeared since Sax's original work, most enjoying no significant success. These include the saxello, essentially a straight B♭ soprano, but with a slightly curved neck and tipped bell; the straight alto; and the straight B♭ tenor.[31] Since a straight-bore tenor is approximately five feet long, the cumbersome size of such a design makes it almost impossible to either play or transport. "King" Saxellos, made by the H. N. White Company in the 1920s, now command prices up to US$4,000. A number of companies, including Rampone & Cazzani and L.A. Sax, are marketing straight-bore, tipped-bell soprano saxophones as saxellos (or "saxello sopranos").

The "contralto" saxophone, similar in size to the orchestral soprano, was developed in the late 20th century by California instrument maker Jim Schmidt.[32] This instrument has a larger bore and a new fingering system, and does not resemble the C melody instrument except for its key and register. Another new arrival to the sax scene is the soprillo sax, a piccolo-sized straight instrument which has the upper speaker hole built into the mouthpiece. The instrument, which extends Sax's original family as it is pitched a full octave higher than the B♭ soprano sax, is manufactured by Benedikt Eppelsheim, of Munich, Germany. There is a rare prototype slide tenor saxophone, but few were ever made. One known company that produced a slide soprano saxophone was Reiffel & Husted, Chicago, ca. 1922 (catalog NMM 5385).[33] [34] [35]

Two of these variants were championed by jazz musician Rahsaan Roland Kirk, who called his straight Buescher alto a stritch and his modified saxello a manzello; the latter featured a larger-than-usual bell and modified key work.

Among some saxophonists, Kirk's terms have taken a life of their own in that it is believed that these were "special" or "new" saxophones that might still be available. Though rare, the Buescher straight alto was a production item

instrument while the manzello was indeed a saxello with a custom made bell.

Another unusual variant of the saxophone was the *Conn-O-Sax*, a straight-conical bore instrument in F (one step above the E♭ alto) with a slightly curved neck and spherical bell. The instrument, which combined a saxophone bore and keys with a bell shaped similar to that of a heckelphone, was intended to imitate the timbre of the English horn and was produced only in 1929 and 1930. The instrument had a key range from low A to high G. Fewer than 100 Conn-O-Saxes are in existence, and they are eagerly sought by collectors.

The tubax, developed in 1999 by the German instrument maker Benedikt Eppelsheim,[36] plays the same range, and with the same fingering, as the E♭ contrabass saxophone; its bore, however, is narrower than that of a contrabass saxophone, making for a more compact instrument with a "reedier" tone (akin to the double-reed contrabass sarrusophone). It can be played with the smaller (and more commonly available) baritone saxophone mouthpiece and reeds. Eppelsheim has also produced subcontrabass tubaxes in C and B♭, the latter being the lowest saxophone ever made. Among the most recent developments is the aulochrome, a double soprano saxophone invented by Belgian instrument maker François Louis in 2001.

Bamboo "saxophones"

Although not true saxophones, inexpensive keyless folk versions of the saxophone made of bamboo were developed in the 20th century by instrument makers in Hawaii, Jamaica, Thailand, Indonesia, Ethiopia, and Argentina. The Hawaiian instrument, called a xaphoon, was invented during the 1970s and is also marketed as a "bamboo sax," although its cylindrical bore more closely resembles that of a clarinet, and its lack of any keywork makes it more akin to a recorder. Jamaica's best known exponent of a similar type of homemade bamboo "saxophone" was the mento musician and instrument maker 'Sugar Belly' (William Walker).[37] In the Minahasa region of the Indonesian island of Sulawesi, there exist entire bands made up of bamboo "saxophones"[38] and "brass" instruments of various sizes. These instruments are clever imitations of European instruments, made using local materials. Very similar instruments are produced in Thailand.[39] [40] In Argentina, Ángel Sampedro del Río and Mariana García have produced bamboo saxophones of various sizes since 1985, the larger of which have bamboo keys to allow for the playing of lower notes.[41] audio [42]

Composition

The extension in C major of the military soprano, alto, tenor and baritone when playing a B♭ major scale.

Music for most saxophones is usually notated using treble clef. The standard written range extends from a B♭ below the staff to an F or F♯ three ledger lines above the staff. Most, if not all, intermediate and professional saxophones made today are built with F♯ keys, with F♯ included on even student instruments. There are many models of soprano saxophone that have a key for high G, and most modern models of baritone saxophone have an extended bore and key to produce low A; it is also possible to play a low A on any saxophone by blocking the end of the bell, usually with the foot or inside of the left thigh. Low A keys however were not limited to just the baritone saxophone. For a short time Selmer Paris produced mark VI alto saxophones with the low A key. Notes above F are considered part of the altissimo register of any sax, and can be produced using advanced embouchure techniques and fingering combinations. Sax himself had mastered these techniques; he demonstrated the instrument as having a range of just beyond three octaves up to a (written) high B4. Modern saxophone players have extended this range to over 4

octaves on tenor and alto respectively.

Because all saxophones use the same key arrangement and fingering to produce a given notated pitch, it is not difficult for a competent player to switch among the various sizes when the music has been suitably transposed, and many do so. Since the baritone and alto are pitched in E♭, players can read concert pitch music notated in the bass clef by reading it as if it were treble clef and adding three sharps to the key signature. This process, referred to as *clef substitution*, makes it possible for the baritone to play from parts written for bassoon, tuba, trombone or string bass. This can be useful if a band or orchestra lacks one of those instruments.

Notes

[1] "June 28, 1846: Parisian Inventor Patents Saxophone" (http://www.wired.com/thisdayintech/2010/06/0628saxophone-patent). Wired.com. . Retrieved 14 February 2011.

[2] "Adolphe Sax" (http://www.basssax.com/adolphesax.htm). BassSax.com. . Retrieved 2007-05-07.

[3] "The history of the saxophone" (http://www.the-saxophone.com/history-of-the-saxophone.html). The-Saxophone.com. . Retrieved 2008-01-06.

[4] MacGillivray, James (May 1959). "Recent Advances in Woodwind Fingering Systems". *The Galpin Society Journal* (The Galpin Society Journal) **12**: 68. doi:10.2307/841949. JSTOR 841949.

[5] "Jay C. Easton: Saxophone Family Gallery" (http://www.jayeaston.com/galleries/sax_family/unusual_saxes_page/sax_php_unusual.html). . Retrieved 2007-05-07.

[6] "Contrabass-L, Vol. 1, No. 76" (http://www.contrabass.com/contra-archive/contra76.html). . Retrieved 2007-05-07.

[7] Photo Gallery :: SaxPics.com (http://www.saxpics.com/?v=gal&a=2082)

[8] Conn 6M "Underslung" alto sax review (http://www.shwoodwind.co.uk/Reviews/Saxes/Alto/Conn_6M.htm)

[9] http://www.woodwindandbrass.co.uk/

[10] Walstein tenor sax review (http://www.shwoodwind.co.uk/Reviews/Saxes/Tenor/Walstein_tenor.htm)

[11] Saxophone Comparisons (http://tamingthesaxophone.com/saxophone-comparisons.html)

[12] Woodwind & Brass Ltd - The Home of Fine Instruments & Accessories OnLine (http://www.woodwindandbrass.co.uk)

[13] Yanagisawa Saxophones (http://web.archive.org/web/20080726114753/http://www.saxophones.co.uk/yanagisawa.htm)

[14] "A992" (http://www.yanagisawasax.co.jp/en/alto/992/). Yanagisawa website. . Retrieved 2008-01-06.

[15] Yanagisawa 992 (bronze) alto saxophone review (http://www.shwoodwind.co.uk/Reviews/Saxes/Alto/Yanagisawa_992_alto.htm)

[16] "T9937" (http://www.yanagisawasax.co.jp/en/tenor/9937/). Yanagisawa website. . Retrieved 2008-01-06.

[17] "tenor_sxr90r_shadow" (http://www.schreiber-keilwerth.com/englisch/keilwerth/instruments/tenor_sx90r_shadow.htm). keilwerth website. . Retrieved 2008-08-21.

[18] "PMST-60NS" (http://www.pmauriatmusic.com/products_detail.php?cde=PDT489a5f02713a9). Paul Mauriat website. . Retrieved 2008-08-22.

[19] "The Horn" (http://www.jazzbarisax.com/brands). JazzBariSax.com. .

[20] "Jazz & Blues Saxophone FAQs" (http://tamingthesaxophone.com/saxophone.html#g). . Retrieved 2007-05-07.

[21] "How Brass Instruments are Built" (http://www.acoustics.org/press/133rd/2amu4.html). Acoustical Society of America. . Retrieved 2007-05-07.

[22] "Saxophone Embouchure and Saxophone Muscles - Learning Saxophone" (http://www.saxstation.com/saxophone-embouchure-and-saxophone-muscles.htm). . Retrieved 2010-01-31.

[23] Teal, Larry (1963). *The Art of Saxophone Playing*. Miami: Summy-Birchard. p. 17. ISBN 0-87487-057-7. "A preference as to material used is up to the individual, and the advantages of each are a matter of controversy. Mouthpieces of various materials which have exactly the same dimensions, including the chamber and outside measurements as well as the facing, play very nearly the same."

[24] "James Fei: DVD" (http://music.columbia.edu/~jamesfei/organizedsound/os4-AltoQuartets.html). . Retrieved 2007-05-07.

[25] "Amherst Saxophone Quartet" (http://web.archive.org/web/20070204160336/http://amherstsaxophonequartet.buffalo.edu/). Archived from the original (http://amherstsaxophonequartet.buffalo.edu/) on 2007-02-04. . Retrieved 2007-05-07.

[26] "AureliaSax4" (http://www.aureliasax4.nl/). . Retrieved 2007-05-07.

[27] "Raschèr Saxophone Quartet" (http://www.rsq-sax.com/). . Retrieved 2007-05-07.

[28] "The Band" (http://www.andyscott.org.uk/sax-assault-cd-sax-gold.htm). SaxAssault.com. . Retrieved 2007-05-07.

[29] "About the Nuclear Whales and their music" (http://web.archive.org/web/20070422144936/http://nuclearwhales.com/info.htm). Archived from the original (http://www.nuclearwhales.com/info.htm) on April 22, 2007. . Retrieved 2007-05-07.

[30] "14th World Saxophone Congress 2006 - Ljubljana - Slovenia" (http://www.worldsax.net). . Retrieved 2007-05-07.

[31] "L.A. Sax Straight Models" (http://www.lasaxophones.com/straight.htm). . Retrieved 2007-05-07.

[32] "Jim Schmidt's Contralto" (http://web.archive.org/web/20070408001917/http://cvip.fresno.com/~js210/contra.html). Archived from the original (http://cvip.fresno.com/~js210/contra.html) on April 8, 2007. . Retrieved 2007-05-07.

[33] "The Royal Holland Bell Ringers Collection and Archive" (http://orgs.usd.edu/nmm/bellring.html). . Retrieved 2006-10-23.

[34] "Slide sax picture at http://www.gs.kunitachi.ac.jp" (http://www.gs.kunitachi.ac.jp/collectiondb/dbpm/ppm1733.jpg). . Retrieved 2006-10-23.
[35] "Slide sax picture at http://www.jasonharron.com" (http://www.jasonharron.com/Slide01.JPG). . Retrieved 2006-10-23.
[36] "Tubax E♭ saxophone" (http://www.eppelsheim.com/tubax.php?lang=en). Benedikt Eppelsheim Wind Instruments. . Retrieved 2007-05-07.
[37] "Mento Music: Sugar Belly" (http://www.mentomusic.com/sugar.htm). . Retrieved 2007-05-07.
[38] "Culture & Arts in North Sulawesi, Indonesia" (http://www.north-sulawesi.org/culture.html). . Retrieved 2007-05-07.
[39] "a bio-aesthetic offspring of single reed woodwinds-Dieter Clermont and his Thai partner Khanung Thuanthee build bamboo saxophones in North Thailand since the late 1980s" (http://www.indochinamusic.com/store/index.php?act=viewDoc&docId=1). . Retrieved 2008-07-31.
[40] "Thai Bamboo Saxophone" (http://web.archive.org/web/20080105100938/http://se-ed.net/bamboosax/HTML/home_eng.html). Archived from the original (http://se-ed.net/bamboosax/HTML\home_eng.html) on 2008-01-05. . Retrieved 2007-05-07.
[41] "Un Mundo de Bambú" (http://www.unmundodebambu.com.ar/pruebai.htm). . Retrieved 2007-05-07.
[42] http://www.oddmusic.com/gallery/om04000.html

References

- Grove, George (January 2001). Stanley Sadie. ed. *The New Grove Encyclopædia of Music and Musicians* (2nd ed.). Grove's Dictionaries of Music. Volume 18, pp534–539. ISBN 1561592390.
- Horwood, Wally (1992) [1983]. *Adolphe Sax, 1814-1894: His Life and Legacy ((Revised edition) ed.). Herts: Egon Publishers. ISBN 0-905858-18-2.*
- Howe, Robert (2003). *Invention and Development of the Saxophone 1840-55*. Journal of the American Musical Instrument Society.
- Ingham, Richard (1998). *The Cambridge Companion to the Saxophone*. Cambridge: Cambridge Univ. Press. ISBN 0521593484.
- Kool, Jaap (1931) (in German). *Das Saxophon*. Leipzig: J. J. Weber. (translated to English as Gwozdz, Lawrence (1987). *The Saxophone*. Egon Publishers Ltd.)
- Kotchnitsky, Léon (1985) [1949]. *Sax and His Saxophone* (fourth ed.). North American Saxophone Alliance.
- Lindemeyer, Paul (1996). *Celebrating the Saxophone*. William Morrow & Co. ISBN 0-688-13518-8.
- Segell, Michael (2005). *The Devil's Horn: The Story of the Saxophone, from Noisy Novelty to King of Cool*. Farrar, Straus and Giroux. ISBN 0-374-15938-6.
- Thiollet, Jean-Pierre (2004). *Sax, Mule & Co*. Paris: H & D. ISBN 2-914-26603-0.
- Marzi, Mario (2009). *Il Saxofono (in italian language)*. The Expression of Music 4. Varese, Italy: Zecchini Editore (Zecchini Publisher). p. 468. ISBN 978-88-87203-86-8.

External links

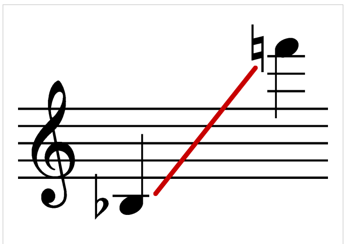
- Instruments In Depth: The Saxophone (http://www.bsmny.org/features/iidsaxophone/index.php) An online feature with video demonstrations from Bloomingdale School of Music (June, 2009)
- Saxophone acoustics (http://www.phys.unsw.edu.au/music/saxophone) from the University of New South Wales.

Soprano saxophone

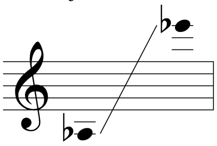
Soprano saxophone

Classification	Wind Woodwind Aerophone
Hornbostel-Sachs classification	422.212-71 (Single-reeded aerophone with keys)
Inventor(s)	Adolphe Sax
Developed	28th June 1846[1]

Playing range



In B♭: sounds a major second lower than written.

Sounding: 

Related instruments

Military band family: • Sopranino saxophone • Soprano saxophone • Alto saxophone • Tenor saxophone • Baritone saxophone • Bass saxophone • Contrabass saxophone • Subcontrabass saxophone Orchestral family: • C soprano saxophone • Mezzo-soprano saxophone • C melody saxophone Other saxophones: • Sopranissimo saxophone ('Soprillo') • Tubax
Musicians
• List of saxophonists
More articles
• Saxophone

The **soprano saxophone** is a variety of the saxophone, a woodwind instrument, invented in 1840. The soprano is the third smallest member of the saxophone family, which consists (from smallest to largest) of the soprillo, sopranino, soprano, alto, tenor, baritone, bass, contrabass and tubax.

A transposing instrument pitched in the key of B♭, modern soprano saxophones with a high F# key have a range from A♭3 to E6 and are therefore pitched one octave above the tenor saxophone. Some saxophones have additional keys, allowing them to play an additional F♯ and G at the top of the range. These extra keys are commonly found on more modern saxophones. Additionally, skilled players can make use of the Altissimo register, which allows them to play even higher. There is also a soprano pitched in C, which is less common and has not been made since around 1940.

The soprano saxophone can be compared to the B♭ clarinet. Although the clarinet can play a diminshed fifth lower and over a fifth higher, the sax generally has a louder and more penetrating sound in the extreme high notes. Due to the smaller bore of the soprano, it is less forgiving with respect to intonation, though an experienced player will use alternate fingerings or vary breath support, tongue position, or embouchure to compensate. Professional players will use the technique of voicing to fix problems with intonation. Due to its similarity in tone to the oboe, the soprano saxophone is sometimes used as a substitute for it.

Soprano saxophones are usually straight, but sometimes have slightly or fully curved necks and bells. The fully curved variety looks much like a small alto saxophone with a straighter crook. There is some debate over the effect of the straight and curved neck, with some players believing that a curved neck on a soprano gives it a warmer, less nasal tone. The soprano has all of the keys on other saxophone models (with the exception of the extra 'A' on some baritones) and some (e.g. those made by Yanagisawa and Bauhaus Walstein) may have a top 'G' key next to the F-sharp key. Soprano saxophone mouthpieces are available in various different designs, allowing players to tailor their tone as required.

In 2001, François Louis created the aulochrome, a new woodwind instrument that is made of two soprano saxophones joined together, which can be played either in unison or in harmony.

Known practitioners

Musicians especially known for playing the soprano saxophone include classical saxophonists Eugene Rousseau, Kenneth Tse, and Jean-Yves Fourmeau. Jazz saxophonists John Coltrane (most notably on the landmark album *My Favorite Things*), Walter Parazaider, Sidney Bechet, Bob Berg, Wayne Shorter, Joe Farrell, Steve Lacy, Lucky Thompson, Sonny Fortune, Anthony Braxton, Gary Bartz, Dan Forshaw, Bennie Maupin, Branford Marsalis, Jan Garbarek, Danny Markovitch of Marbin, Paul Winter, Dave Liebman, Evan Parker, Sam Newsome. Smooth jazz saxophonists Kenny G, Jay Beckenstein, Dave Koz, and Grover Washington, Jr.; and Nigerian Afrobeat singer, Fela Kuti.

In classical music

It was used by Richard Strauss in his Sinfonia Domestica, where included in the music are parts for four saxophones including a soprano saxophone in C.

Ravel's Bolero also features both a tenor and soprano saxophone and both receive solos.

Gallery

Comparison in size of a **curved B♭ soprano saxophone** (centre), an E♭ alto saxophone (left), and a B♭ tenor saxophone (right).

Top to bottom: a curved E♭ sopranino saxophone, a straight E♭ sopranino saxophone, a **C soprano saxophone**, and a **B♭ soprano saxophone**.

B♭ soprano saxophone (left), C soprano saxophone (center), E♭ sopranino saxophone (right).

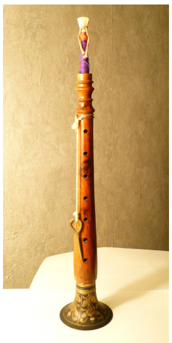
A tenor and soprano saxophone (on the right) made from phosphor bronze, showing their comparative sizes.

References

[1] "June 28, 1846: Parisian Inventor Patents Saxophone" (http://www.wired.com/thisdayintech/2010/06/0628saxophone-patent). Wired.com. . Retrieved 14 February 2011.

Shehnai

Shehnai



Other names	shahnai, shenai
Classification	. • Double reed • Wind • Aerophone
Related instruments	
• nadaswaram • sundari • suona • sopila • zurna	

The **shehnai**, **shahnai**, **shenai** or **mangal vadya**, is an aerophonic (wind) instrument, a double reed conical oboe, common in North India and West India, made out of wood, with a metal flare bell at the end.[1] [2] [3] Its sound is thought to create and maintaining a sense of auspiciousness and sanctity and, as a result, is widely used during marriages, processions, and in temples of West India, although it is also played in concerts. The South Indian equivalent of the shehnai is the nadaswaram.

This tube-like instrument gradually broadens towards the lower end. It usually has between six and nine holes. It employs two sets of double reeds, making it a quadruple reed woodwind. By controlling the breath, various tunes can be played on it.

Ustad (Master) Bismillah Khan was a well-known shehnai player. Another player of the shehnai is the Ahmadi Black American jazz musician, Yusef Lateef. Dave Mason played shehnai on the Rolling Stones' 1968 hit song "Street Fighting Man".

Origin of the shehnai

The origin of North Indian shehnai is believed to be from persian Surna (Sur = feast , Nai=Ney= flute. The shehnai is believed to have originated in the Kashmir Valley, where people use the instrument in *band-i-pather*. The shehnai is thought to have been created by improving upon the pungi (a woodwind folk instrument used primarily for snake charming).

There are varying legends of the shehnai's origin. In one of these, a shah initially banned the playing of the pungi in his court due to its shrill sound. A barber, belonging to a family of musicians, improved on it and created the shehnai. As it was played in the Shah's court and giving due reference to the *nai* or barber, the new instrument was called *shehnai*.

In other variants of the legend, the shehnai was

- named after a shehnai player called Saina,
- derived from *sheh* (breath) and *nai* (flute), or
- derived from the combination of the Persian words *shah* (king), and *nai* (reed, flute) to give the meaning "the king's flute".

Another theory of the origin of the shehnai is that the name is a modification of the word "sur-nal". The word nal/nali/nad is used in many Indian languages to mean pipe or reed. The word "sur" means tone or tune—musical note or simply music—and is used as a prefix to the names of many Indian instruments. The "sur-nal" is said to have given its name to the "surna/zurna" which is the name by which the reed-pipe is known throughout the Middle East and eastern Europe. Shehnai is usually played at traditional North Indian weddings and is associated with the bride leaving her parental house for her husband's house.[4] Sometimes, two shehnais can be tied together, making it a double shawm similar to the ancient Greek aulos.[5]

Whereas the counterparts played in West Indian and Coastal Karnatka are indigenous to the territory.Shenai players were/are an integral part of Goan and other Konkani temples along the coast and the players are called as *Vajantri* and they were alloted lands for services rendered for the temples.[6]

Range

The shehnai has a range of two octaves, from the A below middle C to the A one line above the treble clef (A3 to A5 in scientific pitch notation).

Notes

[1] Shehnai (http://www.britannica.com/EBchecked/topic/765595/shehnai) Britannica.com.
[2] Ranade. p. 307.
[3] Hoiberg, p. 1
[4] Dileep Karanth, The Indian Oboe Reexamined, E-ASPAC 2005, retrieved 5 May 2008 (http://mcel.pacificu.edu/easpac/2005/karanth.php3)
[5] Chalumeau double (picture from the book "Illustrated encyclopedia of Musical Instruments".there are also reeds that are blown through to make it vibrate to make the sound come out (http://www.musicologie.org/sites/c/chalumeaux.html,)
[6] *Gazetteer of the Union Territory Goa, Daman and Diu: district gazetteer, Volume 1*. Gazetteer Dept., Govt. of the Union Territory of Goa, Daman and Diu,. 1979.

References

- Ranade, Ashok Damodar (2006). *Music contexts: a concise dictionary of Hindustani Music* (http://books.google.co.in/books?id=cFwbGi3oBHgC&pg=PA307&dq=Shehnai&cd=2#v=onepage&q=Shehnai&f=false). Bibliophile South Asia. ISBN 8185002630.
- Hoiberg, Dale; Indu Ramchandani (2000). *Students' Britannica India* (http://books.google.co.in/books?id=DPP7O3nb3g0C&pg=PA1&dq=Shehnai&cd=3#v=onepage&q=Shehnai&f=false). Popular Prakashan.

External links

- Listen to Shehnai online on DeshGujarat.Com (http://deshgujarat.com/2007/02/05/vatans-voices-godess-ambajis-aarti-on-shehnaimp3/)
- The Indian Oboe Reexamined (http://mcel.pacificu.edu/easpac/2005/karanth.php3)

Sitar

Sitar

Sitar	
 Miraj sitar	
String instrument	
Other names	sitar
Classification	• Necked bowl lutes • String instruments
Hornbostel-Sachs classification	321.321-6 (Composite chordophone sounded with a plectrum)
Developed	13th century
Related instruments	
• Surbahar • Rudra veena • Saraswati veena • Chitra veena • Vichitra veena • Sarod • Sursingar • Tambura	

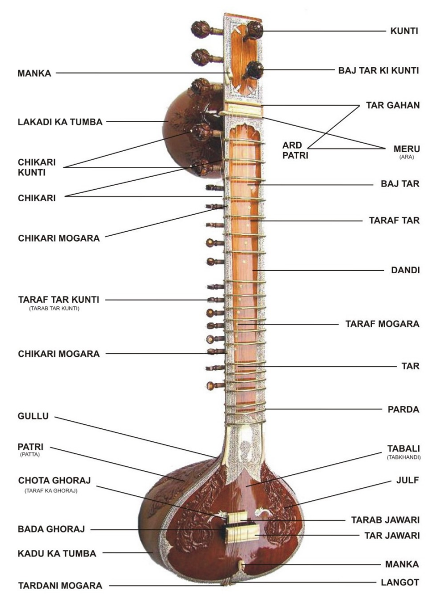
The **sitar** (/ˈsɪtɑr/ or /sɪˈtɑr/; Hindi: सितार, Bengali: সেতার, Urdu: ستار, Persian: سیتار ; Hindustani pronunciation: [ˈsɪ.t̪aːr]) is a plucked stringed instrument predominantly used in Hindustani classical music, where it has been ubiquitous since the Middle Ages. It derives its resonance from sympathetic strings, a long hollow neck and a gourd resonating chamber.

Used throughout the Indian subcontinent, particularly in India, Pakistan, and Bangladesh, the sitar became known in the western world through the work of Pandit Ravi Shankar beginning in the late 1950s and early 1960s after The Kinks' top 10 single "See My Friends" featured a low tuned drone guitar which was widely mistaken to be the instrument[1] . The sitar saw further use in popular music after The Beatles featured the sitar in their compositions, namely "Norwegian Wood (This Bird Has Flown)" and "Within You Without You". Their use of the instrument came as a result of George Harrison taking lessons on how to play it from Shankar and Shambhu Das[2] . Shortly after, The Rolling Stones used a sitar in "Paint It Black" and a brief fad began for using the instrument in pop songs.

Etymology and history

In his *Bharatiya Sangeet Vadya* Dr. Lalmani Misra traces its development from the tritantri veena through the *nibaddh* and *anibaddh tamburas* (so named after Rishi Tumbru), also called *tanbur* and later the *jantra*. Construction of the similar *tanpura* was described by Tansen. During the time of Moghul rule Persian lutes were played at court and may have provided a basis of the sitar. However, there is no physical evidence for the sitar until the time of the collapse of the Mughal Empire.

Mechanics



The anatomy of a sitar

The sitar's curved frets are movable, allowing fine tuning, and raised so that sympathetic strings (*tarb*, also known as "taarif" or "tarafdaar") can run underneath them. A sitar can have 21, 22, or 23 strings, among them six or seven played strings which run over the frets: the *Gandhaar-pancham* sitar (used by Vilayat Khan and his disciples) has six playable strings, whereas the *Kharaj-pancham* sitar, used in the *Maihar gharana*, to which Pt. Ravi Shankar belongs, has seven. Three of these (or four on a *Kharaj-pancham* sitar), called the *chikaari*, simply provide a drone: the rest are used to play the melody, though the first string *(baajtaar)* is most used.

The instrument has two bridges; the large bridge (*badaa gorаa*) for the playing and drone strings and the small bridge (*chota goraa*) for the sympathetic strings. Its timbre results from the way the strings interact with the wide, sloping bridge. As a string reverberates its length changes slightly as its edge touches the bridge, promoting the creation of overtones and giving the sound its distinctive tone. The maintenance of this specific tone by shaping the bridge is called *jawari*. Many musicians rely on instrument makers to adjust this.

Materials used in construction include teak wood or *tun* wood (*Cedrela tuna*), which is a variation of mahogany, for the neck and faceplate (tabli), and gourds for the *kaddu* (the main resonating chamber). The instrument's bridges are made of deer horn, ebony, or very occasionally from camel bone. Synthetic material is now common as well. The sitar may have a secondary resonator, the *tumbaa*, near the top of its hollow neck.

Tuning

Tuning depends on the sitarist's school or style, tradition and each artist's personal preference. Generally, the main playing string is tuned to the tonic of a piece which is called Sa or *vaad* and the drone strings both to that tone and to the *samvaad* or second note, which is usually the perfect fifth. The sympathetic strings are tuned to the notes of the raga being played: although there is slight stylistic variance as to the order of these, typically they are tuned:

- I Sa= D
- VII Ni= C#
- I Sa= D
- II Re= E
- III Ga= F#
- IV Ma= G
- V Pa= A
- VI Dha= B

- VII Ni= C#
- I Sa= D
- II Re= E
- III Ga= F#

(the last three in the upper octave). The player should re-tune for each raga. Strings are tuned by tuning pegs, and the main playing strings can be fine-tuned by sliding a bead threaded on each string just below the bridge.

In one or more of the more common tunings (used by Ravi Shankar, among others, called "Kharaj Pancham" sitar) the playable strings are strung in this fashion:

Jawari

- *Chikari* strings: Sa (high), Sa (middle), and Pa.
- *Kharaj* (bass) strings: Sa (low) and Pa (low).
- *Jod* and *baaj* strings, Sa and Ma.

In a "Gandhar Pancham" (Imdadkhani, school of Vilayat Khan) sitar, the bass or *kharaj* strings are removed and are replaced by a fourth *chikari* which is tuned to Ga. By playing the *chikari* strings with this tuning, one produces a chord (Sa, Sa, Pa, Ga).

To tune the sympathetic strings to raga *Kafi* for example: I Sa, vii ni (lower case denotes flat (*komal*) I Sa, II Re, iii ga, III Ga (*Shuddh* or natural, in Kafi the third is different ascending and descending), iv ma, V Pa, VI Dha, vii ni, I Sa, II Re, iii ga.

There is a lot of stylistic variance within these tunings and like most Indian stringed instruments, there is no default tuning. Mostly, tunings vary by schools of teaching (gharana) and the piece that is meant to be played.

Playing

The instrument is balanced between the player's left foot and right knee. The hands move freely without having to carry any of the instrument's weight. The player plucks the string using a metallic pick or plectrum called a mizraab. The thumb stays anchored on the top of the fretboard just above the main gourd. Generally only the index and middle fingers are used for fingering although a few players occasionally use the third. A specialized technique called "meand" involves pulling the main melody string down over the bottom portion of the sitar's curved frets, with which the sitarist can achieve a 7 semitone range of microtonal notes (it should be noted, however, that because of the sitar's movable frets, sometimes a fret may be set to a microtone already, and no bending would be required). Adept players bring in charisma through use of special techniques like Kan, Krintan, Murki, Zamzama etc. They also use special Mizrab Bol-s, as in Misrabani[3] and create Chhand-s even in odd-numbered Tal-s like Jhoomra.

Sketch of how the sitar is positioned when played.

A sitar workshop in Islamabad, Pakistan.

Popular sitar players in past generations have included:

- Cody William Scott
- Vilayat Khan
- Ravi Shankar
- Sharif Khan (pounchwale)
- Nikhil Banerjee
- Rais Khan
- Abdul Halim Jaffar Khan
- Balaram Pathak
- Mushtaq Ali Khan

Popular sitar players of today include:

- Veronica F Zavel
- Ashraf Sharif Khan
- Nafees Ahmad Khan
- Shahid Parvez
- Anwar Khurshid
- Sugato Nag
- Purbayan Chatterjee

Other modern sitar players of note include:

- Josh Feinberg (American)
- Peter Row (American)
- Johnathan Mayer (English)

Notes

[1] http://www.bbc.co.uk/iplayer/episode/b012ht1t/Dave_Davies_Kinkdom_Come/
[2] Everett, The Beatles as Musicians: Revolver Through the Anthology, p 71.
[3] Ragini Trivedi, *Sitar Compositions in Ome Swarlipi*, ISBN 978-0-557-70596-2, 2010.

External links

- Sitar information (http://www.sitar-tabla.com/sitar information.htm)
- Sitar and Classical Music Resource with Rich Internet Content (http://www.anandvyas.org/)
- Sitar audio and video archives (http://moutal.eu/index.php?option=com_content&view=category&layout=blog&id=100&Itemid=155)
- Sitar and Online Indian Music Resource (http://www.sitarsencat.com/)

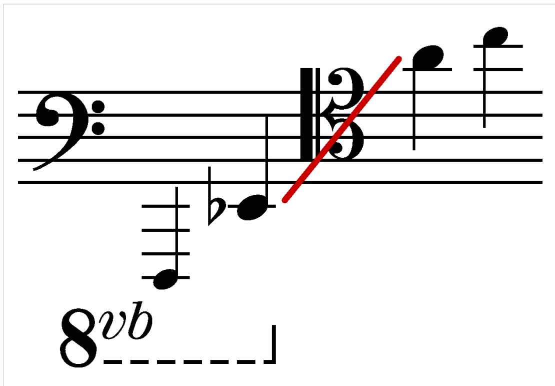
Tuba

Tuba

Two F-tubas, from *c*.1900 (left) and 2004 (right)

Brass instrument	
Classification	• Wind • Brass • Aerophone
Hornbostel-Sachs classification	423.232 (Valved aerophone sounded by lip movement)
Inventor(s)	Wilhelm Friedrich Wieprecht and Carl Moritz
Developed	1835

Playing range



Related instruments

- Subcontrabass tuba
- Euphonium
- Contrabass Bugle
- Baritone horn
- Sousaphone
- Wagner Tuba

Musical instruments
Woodwinds
Brass • Soprano cornet • Cornet • Trumpet • Horn • Trombone • Baritone • Euphonium • Tuba
Percussion
String instruments
Keyboards

The **tuba** is the largest and lowest pitched brass instrument. Sound is produced by vibrating or "buzzing" the lips into a large cupped mouthpiece. It is one of the most recent additions to the modern symphony orchestra, first appearing in the mid-19th century, when it largely replaced the ophicleide. *Tuba* is Latin for trumpet or horn. The horn referred to would most likely resemble what is known as a baroque trumpet.

History

Prussian Patent No. 19 was granted to Wilhelm Friedrich Wieprecht and Carl Moritz[1] on September 12, 1835 for a "basstuba" in F1. The original Wieprecht and Moritz instrument used five valves of the Berlinerpumpen type that were the forerunners of the modern rotary valve.

The addition of valves made it possible to play low in the harmonic series of the instrument and still have a complete selection of notes. Prior to the invention of valves, brass instruments were limited to notes in the harmonic series, and were thus generally played very high with respect to their fundamental pitch. Harmonics starting three octaves above the fundamental pitch are about a whole step apart, making a useful variety of notes possible.

The ophicleide used a cup-shaped brass instrument mouthpiece but employed keys and tone holes similar to those of a modern saxophone. Another forerunner to the tuba was the serpent, a bass brass instrument that was shaped in a wavy form to make the tone holes accessible to the player. Tone holes changed the pitch by providing an intentional leak in the bugle of the instrument. While this changed the pitch, it also had a pronounced effect on the timbre. By using valves to adjust the length of the bugle the tuba produced a smoother tone that eventually led to its popularity.

Adolphe Sax, like Wieprecht, was interested in marketing systems of instruments from soprano to bass, and developed a series of brass instruments known as saxhorns. The instruments developed by Sax were generally pitched in E-flat and B-flat, while the Wieprecht "basstuba" and the subsequent Cerveny contrabass tuba were pitched in F and C (see below on pitch systems). Sax's instruments gained dominance in France, and later in Britain and America, as a result of the popularity and movements of instrument makers such as Gustave Auguste Besson (who moved from France to Britain) and Henry Distin (who found his way eventually to America). [2]

Roles

An orchestra usually has a single tuba, though an additional tuba may be asked for. It is the principal bass instrument in symphonic and military bands, and those ensembles generally have more. It serves as the bass of the brass section and of brass quintets and choirs, as well as reinforcement for the bass voices of the strings and woodwinds, and as a solo instrument.

Well known and influential parts for the tuba include:

- Modest Mussorgsky (orch. Ravel): *Pictures at an Exhibition - Bydlo*
- Richard Strauss: *Also sprach Zarathustra*, *Eine Alpensinfonie*
- Shostakovich: Fifth symphony
- Stravinsky: *The Rite of Spring*
- Edgard Varèse: *Déserts*
- Richard Wagner: *Die Meistersinger von Nürnberg*, *Lohengrin*, *Ride of the Valkyries*
- Sergei Prokofiev: Fifth Symphony
- George Gershwin: *An American in Paris*
- Silvestre Revueltas: *Sensemayá, Noche de los mayas, Homenaje a Federico García Lorca*

Concertos have been written for the tuba by many notable composers, including Ralph Vaughan Williams, Edward Gregson, John Williams, Alexander Arutiunian, Eric Ewazen, James Barnes, Martin Ellerby, Philip Sparke, Kalevi Aho, Arild Plau, James Woodward, Victor Davies, Josef Tal and Bruce Broughton. Joseph Hallman's Concerto for tuba and chamber orchestra was written for and premiered by the Philadelphia Orchestra's tubist, Carol Jantsch in May 2007. Tubas are also used in concert bands, marching bands, drum and bugle corps, drum and brass corps, and in many jazz bands (see below). In British style brass bands, both E-flat and B-flat tubas are used and are normally referred to as *basses*.

Types and construction


Tuba section in a British style brass band.

Tubas are found in various pitches, most commonly in F, E-flat, C, or B-flat. The main tube of a B-flat tuba is approximately 18 feet long, while that of a C tuba is 16 feet, of an E-flat tuba 13 feet, and of an F tuba 12 feet. The instrument has a conical bore, meaning the bore diameter increases as a function of the tubing length from the mouthpiece to the bell. The conical bore causes the instrument to produce a preponderance of even-order harmonics.

A tuba with its tubing wrapped for placing the instrument on the player's lap is usually called a concert tuba or simply a tuba. Tubas with the bell pointing forward (*pavillon tournant*) instead of upward are often called *recording tubas* because of their popularity in the early days of recorded music, as their sound could more easily be directed at the recording instrument. When wrapped to surround the body for marching, it is traditionally known as a hélicon. The modern **sousaphone**, named after American bandmaster John Philip Sousa, resembles a hélicon with the bell pointed up and then curved to point forward. Some ancestors of the tuba, such as the military *bombardon*, were wrapped so that the bell extended far backwards over the player's shoulder. These instruments were commonly used in military bands during the American Civil War, and are known as "over-the-shoulder saxhorns".

Most music for tuba is written in bass clef in concert pitch, so tuba players must know the correct fingerings for their specific instrument. Traditional British-style brass band parts for the tuba are usually written in treble clef, with the

B-flat tuba sounding two octaves and one step below and the E-flat tuba sounding one octave and a major sixth below the written pitch. This allows musicians to change instruments without learning new fingerings for the same written music. Consequently, when its music is written in treble clef, the tuba is a transposing instrument, but not when the music is in bass clef.

The lowest pitched tubas are the **contrabass tubas**, pitched in C or B-flat; (referred to as CC and BB-flat tubas respectively, based on a traditional distortion of a now-obsolete octave naming convention). The fundamental pitch of a CC tuba is 32 Hz, and for a BB-flat tuba, 29 Hz. The CC tuba is used as an orchestral instrument in the U.S., but BB-flat tubas are the contrabass tuba of choice in German, Austrian, and Russian orchestras. In the United States the BB-flat tuba is the most common in schools (largely due to the use of BBb sousaphones in high school marching bands) and for adult amateurs. Most professionals in the U.S. play CC tubas, with BBb also common, and many train in the use of all four pitches of tubas.

The next smaller tubas are the **bass tubas**, pitched in F or E-flat (a fourth above the contrabass tubas). The E-flat tuba often plays an octave above the contrabass tubas in brass bands, and the F tuba is commonly used by professional players as a solo instrument and, in America, to play higher parts in the classical repertoire (or parts that were originally written for the F tuba, as is the case with Berlioz). In most of Europe, the F tuba is the standard orchestral instrument, supplemented by the CC or BB-flat only when the extra weight is desired. Wagner, for example, specifically notates the low tuba parts for "Kontrabasstuba," which are played on CC or BB-flat tubas in most regions. In the United Kingdom, the E-flat is the standard orchestral tuba.


Comparison of euphonium (left) and tuba (right)

The euphonium is sometimes referred to as a **tenor tuba** and is pitched in B-flat, one octave higher than the BB-flat contrabass tuba. The term "tenor tuba" is often used more specifically to refer to B-flat rotary-valved tubas pitched in the same octave as euphoniums. The "Small French Tuba in C" is a tenor tuba pitched in C, and provided with 6 valves to make the lower notes in the orchestral repertoire possible. The French C tuba was the standard instrument in French orchestras until overtaken by F and C tubas since the Second World War. One popular example of the use of the French C tuba is the *Bydło* movement in Ravel's orchestration of Mussorgsky's *Pictures at an Exhibition*, though the rest of the work is scored for this instrument as well.

Larger BBB-flat **subcontrabass tubas** exist, but are extremely rare (there are at least four known examples). The first two were built by the Gustav Besson in BBB-flat, one octave below the BB-flat Contrabass tuba, on the suggestion of John Philip Sousa. The monster instruments were not completed until just after Sousa's death. Later, in the 1950s, British musician Gerard Hoffnung commissioned the London firm of Paxman to create a subcontrabass tuba in EEE-flat for use in his comedic music festivals. Also, a tuba pitched in FFF was made in Kraslice by Bohland & Fuchs probably during 1910 or 1911 and was destined for the World Exhibition in New York in 1913. Two players are needed; one to operate the valves and one to blow into the mouthpiece.

Size vs. pitch

In addition to the length of the instrument, which dictates the fundamental pitch, tubas also vary in overall width of the tubing sections. Tuba sizes are usually denoted by a quarter system, with 4/4 designating a normal, full-size tuba. Larger rotary instruments are known as *kaisertubas* and are often denoted 5/4. Larger piston tubas, particularly those with front action, are sometimes known as *grand orchestral tubas* (examples: The Conn 36J Orchestra Grand Bass from the 1930s, and the current model Hirsbrunner HB-50 "Grand Orchestral," which is a replica of the large York tubas owned by the Chicago Symphony Orchestra). Grand orchestral tubas are generally described as 6/4 tubas. Smaller instruments may be described as 3/4 instruments. No standards exist for these designations, and their use is

up to manufacturers who usually use them to distinguish among the instruments in their own product line. The size designation is related to the larger outer branches, and not to the bore of the tubing at the valves, though the bore is usually reported in instrument specifications. The quarter system is also not related to bell size, at least across manufacturers.

Valves

Tubas are made with either piston or rotary valves. Rotary valves, invented by Joseph Riedl, are based on a design included in the original valve patents by Friedrich Blühmel and Heinrich Stölzel in 1818. Červeny of Graslitz was the first to use true rotary valves, starting in the 1840s or 1850s. Modern Piston valves were developed by Perinet for the saxhorn family of instruments promoted by Adolphe Sax around the same time. Pistons may either be oriented to point to the top of the instrument (top-action, as pictured in the figure at the top of the article) or out the front of the instrument (front-action or side-action). There are advantages and disadvantages to each valve style, but assertions concerning sound, speed, and clarity are difficult to quantify. German players generally prefer rotary valves while British and American players favor piston valves - the choice of valve type remains up to the performer.

Piston valves require more maintenance than rotary valves — they require daily oiling to keep them freely operating, while rotary valves are sealed and seldom require oiling. Piston valves are easy to disassemble and re-assemble, while rotary valve disassembly and re-assembly is much more difficult and is generally left to qualified instrument repair persons.

Tubas generally have from three to six valves, though some rare exceptions exist. Three-valve tubas are generally the least expensive and are almost exclusively used by beginners and amateurs, and the sousaphone (a marching version of a BB-flat tuba) almost always has three valves. Among advanced players, four and five valve tubas are by far the most common choices, with six-valve tubas being relatively rare except among F tubas, which mostly have five or six valves.

The valves add tubing to the main tube of the instrument, thus lowering its fundamental pitch. The first valve lowers the pitch by a whole step (two semitones), the second valve by a semitone, and the third valve by three semitones. Used in combination, the valves are too short and the resulting pitch tends to be sharp. For example, a BB-flat tuba becomes (in effect) an A-flat tuba when the first valve is depressed. The third valve is long enough to lower the pitch of a BB-flat tuba by three semitones, but it is not long enough to lower the pitch of an A-flat tuba by three semitones. Thus, the first and third valves used in combination lower the pitch by something *just short* of five semitones, and the first three valves used in combination are nearly a quarter tone sharp.

Tuba with four rotary valves.

The fourth valve is used in place of combinations of the first and third valves, and the second and fourth used in combination are used in place of the first three valves in combination. The fourth valve can be tuned to lower the pitch of the main tube accurately by five semitones, and thus its use corrects the main problem of combinations being too sharp. By using the fourth valve by itself to replace the first and third combination, or the fourth and second valves in place of the first, second and third valve combinations, the notes requiring these fingerings are more in tune.

The fifth and sixth valves are used to provide alternative fingering possibilities to improve intonation, and are also used to reach into the low register of the instrument where all the valves will be used in combination to fill the first octave between the fundamental pitch and the next available note on the open tube. The fifth and sixth valves also give the musician the ability to trill more smoothly or to use alternative fingerings for ease of playing.

The bass tuba in F is pitched a fifth above the BB-flat tuba and a fourth above the CC tuba, so it needs additional tubing length beyond that provided by four valves to play securely down to a low F as required in much tuba music.

The fifth valve is commonly tuned to a flat whole step, so that when used with the fourth valve, it gives an in-tune low B-flat. The sixth valve is commonly tuned as a flat half step, allowing the F tuba to play low G as 1-4-5-6 and low G-flat as 1-2-4-5-6. In CC tubas with five valves, the fifth valve may be tuned as a flat whole step or as a minor third depending on the instrument.

Resonance and false tones

Some tubas have a strong and useful resonance that is not in the well-known harmonic series. For example, most large B-flat tubas have a strong resonance at low E-flat (E-flat1, 39 Hz), which is between the fundamental and the second harmonic (an octave higher than the fundamental). These alternative resonances are often known as false tones or privileged tones. Adding the six semitones provided by the three valves, these alternative resonances allow the instrument to be played chromatically down to the fundamental of the open bugle, (which is a 29 Hz B-flat). The addition of valves below that note can lower the instrument a further six semitones to a 20 Hz E0. Thus, even three-valved instruments with good alternative resonances can produce very low sounds in the hands of skilled players; instruments with four valves can play even lower. The lowest note in the widely known repertoire is a 16 Hz double-pedal C in the William Kraft piece *Encounters II*, which is often played using a timed flutter tongue rather than by buzzing the lips. The fundamental of this pitch borders on infrasound and its overtones define the pitch in the listener's ear.

The most convincing explanation for false-tones is that the horn is acting as a 'third of a pipe' rather than as a half-pipe. The bell remains an anti-node, but there would then be a node 1/3 of the way back to the mouthpiece. If so, it seems that the fundamental would be missing entirely, and would only be inferred from the overtones. However, the node and the anti-node collide in the same spot and cancel out the fundamental.

Some tubas have a compensating system to allow accurate tuning when using several valves in combination, simplifying fingering and removing the need to constantly adjust slide positions. The most popular of the automatic compensation systems was invented by Blaikley (Bevan, 1978) and was patented by Boosey (later, Boosey and Hawkes, which also, later still, produced Besson instruments). The patent on the system limited its application outside of Britain, and to this day tubas with compensating valves are primarily popular in the United Kingdom and countries of the former British Empire. The Blaikley design plumbs the instrument so that if the fourth valve is used, the air is sent back through a second set of branches in the first three valves to compensate for the combination of valves. This does have the disadvantage of making the instrument significantly more 'stuffy' or resistant to air flow when compared to a non-compensating tuba. This is due to the need for the air to flow through the valves twice. It also makes the instrument heavier. But many prefer this approach to additional valves or to manipulation of tuning slides while playing to achieve improved intonation within an ensemble. Most modern professional-grade euphoniums now feature Blaikley-style compensating valves.

Materials and finish

The tuba is generally constructed of brass, which is either unfinished, lacquered or electro-plated with nickel, gold or silver. Unfinished brass will eventually tarnish and thus must be periodically polished to maintain its appearance. There is some belief that the external finish of the tuba can play an important role in the tone production, which has never been scientifically proved. Performers have individual preferences on the finish that they select, and will sometimes have horns in more than one finish for different musical settings.

Variations

Some tubas are capable of being converted into a marching style, known as "marching tubas". A leadpipe can be manually screwed on next to the valves. The tuba is then usually rested on the left shoulder (although some tubas allow use of the right shoulder), with the bell facing directly in front of the player. Some marching tubas are made only for marching, and cannot be converted into a concert model. Most marching bands opt for the sousaphone, an instrument that is easier to carry and almost always cheaper than a true marching tuba. Drum and bugle corps players, however, generally use marching tubas, which, in this context, are called contras. Standard tubas can also be played whilst standing, with the use of a strap joined to the tuba with two rings. The strap goes over the player's shoulder like a sash, allowing the instrument to be played in the same position as when sitting.

Jazz

"Kaiserbass" (tuba in B♭) and cornet

The tuba has been used in jazz since the genre's inception. In the earliest years, bands often used a tuba for outdoor playing and a double bass for indoor performances. In this context, the tuba was sometimes called "brass bass", as opposed to the double bass, which was called "string bass"; it was not uncommon for players to double on both instruments.

When used in modern jazz, tubas usually fill the traditional bass role, although it is not uncommon for them to take solos. New Orleans style Brass Bands like Dirty Dozen Brass Band, Rebirth Brass Band, and Nightcrawlers Brass Band feature a sousaphone as the bass instrument. Miles Davis made use of a tuba, played by Bill Barber, in his album *Birth of the Cool*, released in June, 1950. One of the most prominent tubists specializing in jazz is the New York City-based Marcus Rojas, who has performed frequently with bandleader Henry Threadgill. Another notable group is the Modern Jazz Tuba Project, founded by R. Winston Morris, which consists entirely of tubas and euphoniums with rhythm section.

The tuba has also played a large role in ragtime music and in big band music.

Notable tubists

See List of tuba players

References

[1] VIENNA SYMPHONIC LIBRARY > VIENNA ACADEMY > Brass > Tubas > Bass tuba > HISTORY (http://vsl.co.at/en/70/3139/3153/3154/5493.vsl)
[2] Clifford Bevan, *The Tuba Family*, Scriveners, 1978.

External links

- The International Tuba-Euphonium Association. (http://www.iteaonline.org)
- Tuba News, a free monthly online publication for tuba and euphonium players. (http://www.tubanews.com/)
- International Tuba Day (http://www.tubaday.com)
- Tubenet Sean Chisham's popular Tubenet discussion forum. (http://www.chisham.com/index.html)
- Brass-Forum.co.uk UK based brass discussion forum. (http://www.brass-forum.co.uk)

- Brassmusic.Ru — Russian Brass Community (http://www.brassmusic.ru)
- The Wagner tuba (http://www.wagner-tuba.com)
- Acoustics of Brass Instruments (http://www.phys.unsw.edu.au/~jw/brassacoustics.html) from Music Acoustics (http://www.phys.unsw.edu.au/music) at the University of New South Wales.
- Tuba/Sousaphone as blues instruments (http://www.wirz.de/music/tuba.htm)
- More Thoughts on Tuba (http://www.dwerden.com/tu-articles-morethoughts.cfm)
- Official site for the annual TubaChristmas concerts in the US, Victoria BC and Switzerland (http://www.tubachristmas.com/)
- Paul Haugan Historical Tuba Collection (http://www.tubanews.com/index.php?option=com_content&view=article&id=245:the-paul-haugan-historical-tuba-collection&catid=36:essays&Itemid=86)
- The Four-Valve Compensating System (http://www.dwerden.com/eu-articles-comp.cfm)
- Chisholm, Hugh, ed (1911). "Bombardon". *Encyclopædia Britannica* (11th ed.). Cambridge University Press.

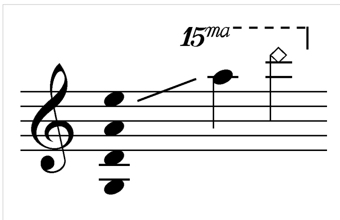
Violin

Violin

A standard modern violin shown from the front and the side

String instrument	
Other names	Fiddle, de: *Violine* or *Geige,* fr: *Violon,* it: *Violino*
Hornbostel-Sachs classification	321.322-71 (Composite chordophone sounded by a bow)
Developed	Early 16th century

Playing range



Related instruments

- **Violin family** (viola, cello)
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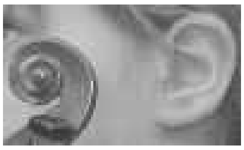

This article is part of the Fiddle and Violin series.

- Basic physics of the violin
- Fiddlers
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The **violin** is a string instrument, usually with four strings tuned in perfect fifths. It is the smallest, highest-pitched member of the violin family of string instruments, which includes the viola and cello.

The violin is sometimes informally called a fiddle, regardless of the type of music played on it. The word *violin* comes from the Middle Latin word *vitula*, meaning *stringed instrument*;[1] this word is also believed to be the source of the Germanic "fiddle".[2] The violin, while it has ancient origins, acquired most of its modern characteristics in 16th-century Italy, with some further modifications occurring in the 18th and 19th centuries. Violinists and collectors particularly prize the instruments made by the Gasparo da Salò, Giovanni Paolo Maggini, Stradivari, Guarneri and Amati families from the 16th to the 18th century in Brescia and Cremona and by Jacob Stainer in Austria. Great numbers of instruments have come from the hands of "lesser" makers, as well as still greater numbers of mass-produced commercial "trade violins" coming from cottage industries in places such as Saxony, Bohemia, and Mirecourt. Many of these trade instruments were formerly sold by Sears, Roebuck and Co. and other mass merchandisers.

A person who makes or repairs violins is called a luthier, or simply a violin maker. The parts of a violin are usually made from different types of wood (although electric violins may not be made of wood at all, since their sound may not be dependent on specific acoustic characteristics of the instrument's construction), and it is usually strung with gut, nylon or other synthetic, or steel strings.

Someone who plays the violin is called a violinist or a fiddler. The violinist produces sound by drawing a bow across one or more strings (which may be stopped by the fingers of the other hand to produce a full range of pitches), by plucking the strings (with either hand), or by a variety of other techniques. The violin is played by musicians in a wide variety of musical genres, including Baroque music, classical, jazz, folk music, and rock and roll. The violin has come to be played in many non-western music cultures all over the world.

History


Batchelder violin (USA)

The earliest stringed instruments were mostly plucked (e.g. the Greek lyre). Bowed instruments may have originated in the equestrian cultures of Central Asia, an example being the Kobyz (Kazakh: қобыз) or kyl-kobyz is an ancient Turkic, Kazakh string instrument or Mongolian instrument Morin huur:

> Turkic and Mongolian horsemen from Inner Asia were probably the world's earliest fiddlers. Their two-stringed upright fiddles were strung with horsehair strings, played with horsehair bows, and often feature a carved horse's head at the end of the neck. ... The violins, violas, and cellos we play today, and whose bows are still strung with horsehair, are a legacy of the nomads.[3]

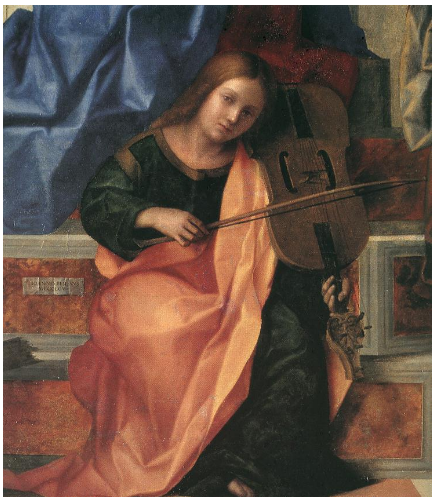
It is believed that these instruments eventually spread to China, India, the Byzantine Empire and the Middle East, where they developed into instruments such as the erhu in China, the rebab in the Middle East, the lyra in the Byzantine Empire and the esraj in India. The violin in its present form emerged in early 16th-Century Northern Italy, where the port towns of Venice and Genoa maintained extensive ties to central Asia through the trade routes of the silk road.

The modern European violin evolved from various bowed stringed instruments from the Middle East[4] and the Byzantine Empire.[5] [6] It is most likely that the first makers of violins borrowed from three types of current instruments: the rebec, in use since the 10th century (itself derived from the Byzantine lyra[7] and the Arabic *rebab*), the Renaissance fiddle, and the *lira da braccio*[8] (derived[5] from the *Byzantine lira*). One of the earliest explicit descriptions of the instrument, including its tuning, was in the *Epitome musical* by Jambe de Fer, published in Lyon in 1556.[9] By this time, the violin had already begun to spread throughout Europe.

The oldest documented violin to have four strings, like the modern violin, is supposed to have been constructed in 1555 by Andrea Amati, but the date is very doubtful. (Other violins, documented significantly earlier, only had three strings and were called *violetta*.) The violin immediately became very popular, both among street musicians and the nobility, illustrated by the fact that the French king Charles IX ordered Amati to construct 24 violins for him in 1560.[10] The oldest surviving violin, dated inside, is from this set, and is known as the *Charles IX*, made in Cremona c. 1560. The finest Renaissance carved and decorated violin in the world is the Gasparo da Salò (1574 c.) owned by Ferdinand II, Archduke of Austria and later, from 1841, by the Norwegian virtuoso Ole Bull, who used it for forty years and thousands of concerts, for his very powerful and beautiful tone, similar to those of a Guarneri. It is now in the Vestlandske Kustindustrimuseum in Bergen (Norway). "The Messiah" or *"Le Messie"* (also known as the "Salabue") made by Antonio Stradivari in 1716 remains pristine. It is now located in the Ashmolean Museum of Oxford.[11]

The most famous violin makers (luthiers) between the 16th century and the 18th century include:

- The school of Brescia, beginning in the late 14th with liras, violettas, violas and active in the field of the violin in the first half of 16th century
- The Dalla Corna family, active 1510–1560 in Brescia and Venezia, Italy
- The Micheli family, active 1530–1615 in Brescia
- The Inverardi family active 1550–1580 in Brescia
- The Bertolotti Gasparo da Salò family, active 1530–1615 in Salò and Brescia
- Giovanni Paolo Maggini, active 1600–1630 in Brescia
- The school of Cremona, beginning in the half of 16 century vith violas and violone and in the field of violin in the second half of 16 century
- The Amati family, active 1500–1740 in Cremona, Italy
- The Guarneri family, active 1626–1744 in Cremona
- The Stradivari family, active 1644–1737 in Cremona



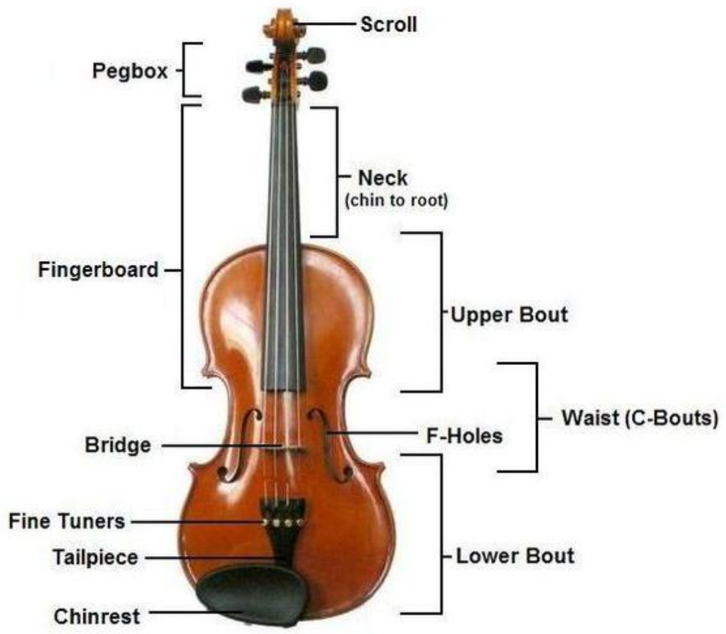
Detail of the San Zaccaria Altarpiece, Venice, by Giovanni Bellini, 1505.

Significant changes occurred in the construction of the violin in the 18th century, particularly in the length and angle of the neck, as well as a heavier bass bar. The majority of old instruments have undergone these modifications, and hence are in a significantly different state than when they left the hands of their makers, doubtless with differences in sound and response.[12] But these instruments in their present condition set the standard for perfection in violin craftsmanship and sound, and violin makers all over the world try to come as close to this ideal as possible.

To this day, instruments from the so-called Golden Age of violin making, especially those made by Stradivari and Guarneri del Gesù, are the most sought-after instruments by both collectors and performers. The current record amount paid for a Stradivari violin is £9.8 million (US$15.9 million), when the instrument known as the Lady Blunt was sold by Tarisio Auctions in an online auction on June 20, 2011.[13]

Construction and mechanics

A violin typically consists of a spruce top (the soundboard, also known as the *top plate*, *table*, or *belly*), maple ribs and back, two endblocks, a neck, a bridge, a soundpost, four strings, and various fittings, optionally including a chinrest, which may attach directly over, or to the left of, the tailpiece. A distinctive feature of a violin body is its hourglass-like shape and the arching of its top and back. The hourglass shape comprises two upper bouts, two lower bouts, and two concave C-bouts at the *waist*, providing clearance for the bow.



The construction of a violin

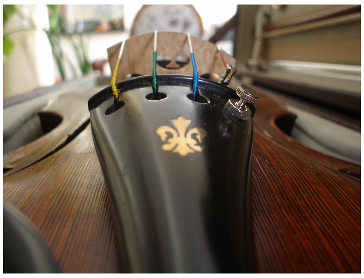
The voice of a violin depends on its shape, the wood it is made from, the graduation (the thickness profile) of both the top and back, and the varnish that coats its outside surface. The varnish and especially the wood continue to improve with age, making the fixed supply of old violins much sought-after.

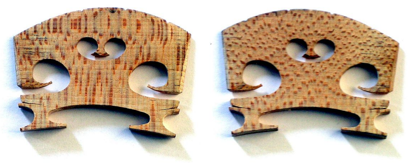
The very great majority of glued joints in the instrument use animal hide glue for a number of reasons: it is capable of making a thinner joint than most other glues, it is reversible (brittle enough to crack with carefully applied force, and removable with warm water) when disassembly is needed, and since fresh hide glue sticks to old hide glue, more original wood can be preserved when repairing a joint. (More modern glues must be cleaned off entirely for the new joint to be sound, which generally involves scraping off some wood along with the old glue.) Weaker, diluted glue is usually used to fasten the top to the ribs, and the nut to the fingerboard, since common repairs involve removing these parts.

The purfling running around the edge of the spruce top provides some protection against cracks originating at the edge. It also allows the top to flex more independently of the rib structure. Painted-on faux purfling on the top is usually a sign of an inferior instrument. The back and ribs are typically made of maple, most often with a matching striped figure, referred to as *flame*, *fiddleback*, or *tiger stripe*.

The neck is usually maple with a flamed figure compatible with that of the ribs and back. It carries the fingerboard, typically made of ebony, but often some other wood stained or painted black. Ebony is the preferred material because of its hardness, beauty, and superior resistance to wear. Fingerboards are dressed to a particular transverse curve, and have a small lengthwise "scoop," or concavity, slightly more pronounced on the lower strings, especially when meant for gut or synthetic strings.

Some old violins (and some made to appear old) have a grafted scroll, evidenced by a glue joint between the pegbox and neck. Many authentic old instruments have had their necks reset to a slightly increased angle, and lengthened by about a centimeter. The neck graft allows the original scroll to be kept with a Baroque violin when bringing its neck into conformance with modern standards.


Closeup of a violin tailpiece, with a fleur-de-lis


Front and back views of violin bridge


Sound post seen through f-hole

The bridge is a precisely cut piece of maple that forms the lower anchor point of the vibrating length of the strings and transmits the vibration of the strings to the body of the instrument. Its top curve holds the strings at the proper height from the fingerboard in an arc, allowing each to be sounded separately by the bow. The sound post, or *soul post*, fits precisely inside the instrument between the back and top, below the treble foot of the bridge, which it helps support. It also transmits vibrations between the top and the back of the instrument.

The tailpiece anchors the strings to the lower bout of the violin by means of the tailgut, which loops around an ebony button called the tailpin (sometimes confusingly called the *endpin*, like the cello's spike), which fits into a tapered hole in the bottom block. Very often the E string will have a fine tuning lever worked by a small screw turned by the fingers. Fine tuners may also be applied to the other strings, especially on a student instrument, and are sometimes built into the tailpiece.

At the scroll end, the strings wind around the tuning pegs in the pegbox. Strings usually have a colored silk wrapping at both ends, for identification and to provide friction against the pegs. The tapered pegs allow friction to be increased or decreased by the player applying appropriate pressure along the axis of the peg while turning it.

Violin and bow.

Strings

Strings were first made of sheep gut (commonly known as catgut), or simply gut, which was stretched, dried, and twisted. Modern strings may be gut, solid steel, stranded steel, or various synthetic materials, wound with various metals, and sometimes plated with silver. Most E strings are unwound, either plain or gold-plated steel.

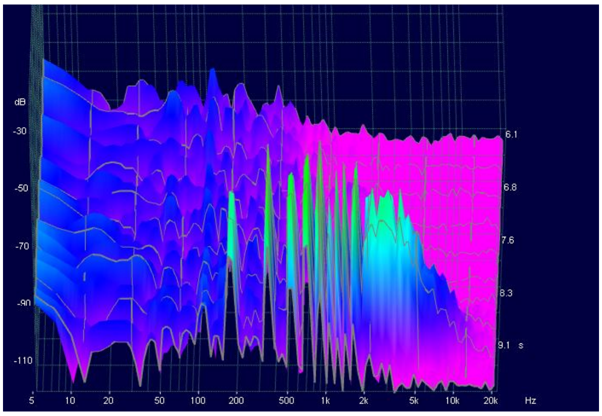
Strings have a limited lifetime. Apart from obvious things, such as the winding of a string coming undone from wear, players generally change a string when it no longer plays true, losing the desired tone. String longevity depends on string quality and playing intensity.

Pitch range

The compass of the violin is from G3 (G below middle C) to C8 (the highest note of the modern piano.) The top notes, however, are often produced by natural or artificial harmonics. Thus the E two octaves above the open E-string may be considered a practical limit for orchestral violin parts.[14]

Acoustics

The arched shape, the thickness of the wood, and its physical qualities govern the sound of a violin. Patterns of the node made by sand or glitter sprinkled on the plates with the plate vibrated at certain frequencies, called *Chladni patterns*, are occasionally used by luthiers to verify their work before assembling the instrument.[15]



3D spectrum diagram of the overtones of a violin G string (foreground). Note that the pitch we hear is the peak around 200 Hz.

Sizes

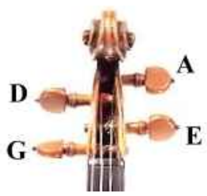

Fractional (1/16) and full size (4/4) violins

Children typically use smaller string instruments than adults. Violins are made in so-called *fractional* sizes for young students: Apart from full-size (4/4) violins, 3/4, 1/2, 1/4, 1/8, 1/10, 1/16, 1/32 and even 1/64-sized instruments exist, although these smaller sizes are highly unusual and usually custom-made. Extremely small sizes were developed, along with the Suzuki program, for violin students as young as 3. Finely made fractional sized violins, especially smaller than 1/2 size, are extremely rare or non-existent. Such small instruments are typically intended for beginners needing a rugged violin, and whose rudimentary technique does not justify the expense of a more carefully made one.

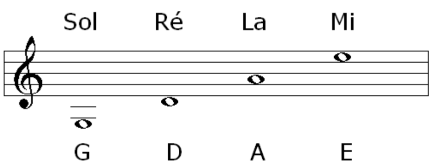
These fractional sizes have nothing to do with the actual dimensions of an instrument; in other words, a 3/4-sized instrument is *not* three-quarters the length of a full size instrument. The body length (not including the neck) of a full-size, or 4/4, violin is about 14 inches (35 cm), smaller in some 17th century models. A 3/4 violin is about 13 inches (33 cm), and a 1/2 size is approximately 12 inches (30 cm). With the violin's closest family member, the viola, size is specified as body length in inches or centimeters rather than fractional sizes. A full-size viola averages 16 inches (40 cm).

Occasionally, an adult with a small frame may use a so-called 7/8 size violin instead of a full-size instrument. Sometimes called a *lady's violin*, these instruments are slightly shorter than a full size violin, but tend to be high-quality instruments capable of producing a sound that is comparable to that of fine full size violins.

Tuning



Scroll and pegbox, correctly strung



The pitches of open strings on a violin

Violins are tuned by turning the pegs in the pegbox under the scroll, or by adjusting the *fine tuner* screws at the tailpiece. All violins have pegs; fine tuners (also called *fine adjusters*) are optional. Most fine tuners consist of a metal screw that moves a lever attached to the string end. They permit very small pitch adjustments much more easily than the pegs. By turning one clockwise, the pitch becomes sharper and turning one counterclockwise, the pitch becomes flatter.

Fine tuners on all four of the strings are a practical necessity for playing steel-core strings, and some players use them with synthetic strings as well. Since modern E strings are steel, a fine tuner is typically fitted for that string. Fine tuners are not used with gut strings, which are more elastic than steel or synthetic-core strings and do not respond adequately to the very small movements of fine tuners.

To tune a violin, the A string is first tuned to a standard pitch (usually 440 Hz), using either a tuning device or another instrument. (When accompanying a fixed-pitch instrument such as a piano or accordion, the violin tunes to it.) The other strings are then tuned against each other in intervals of perfect fifths by bowing them in pairs. A minutely higher tuning is sometimes employed for solo playing to give the instrument a brighter sound; conversely, Baroque music is sometimes played using lower tunings to make the violin's sound more gentle. After tuning, the instrument's bridge may be examined to ensure that it is standing straight and centered between the inner nicks of the f-holes; a crooked bridge may significantly affect the sound of an otherwise well-made violin.

The tuning G-D-A-E is used for most violin music. Other tunings are occasionally employed; the G string, for example, can be tuned up to A. The use of nonstandard tunings in classical music is known as *scordatura*; in some folk styles, it is called *cross-tuning*. One famous example of scordatura in classical music is Saint-Saëns' *Danse Macabre*, where the solo violin's E string is tuned down to E flat to impart an eerie dissonance to the composition. Another example is in the third movement of *Contrasts*, by Béla Bartók, where the E string is tuned down to E flat and the G tuned to a G sharp, or the set of pieces called the Mystery Sonatas by Biber.

In Indian classical music and Indian light music, the violin is likely to be tuned to D♯-A♯-D♯-A♯ in the South Indian style. As there is no concept of absolute pitch in Indian classical music, any convenient tuning maintaining these relative pitch intervals between the strings can be used. Another prevalent tuning with these intervals is F-B♭-F-B♭, which corresponds to Sa-Pa-Sa-Pa in the Indian carnatic classical music style. In the North Indian Hindustani style, the tuning is usually Pa-Sa-Pa-Sa instead of Sa-Pa-Sa-Pa. This could correspond to B♭-F-B♭-F, for instance.

While most violins have four strings, there are violins with as many as seven strings. The extra strings on such violins typically are lower in pitch than the G-string; these strings are usually tuned to C, F, and B flat. If the instrument's playing length, or string length from nut to bridge, is equal to that of an ordinary full-scale violin; i.e., a bit less than 13 inches (330 mm), then it may be properly termed a violin. Some such instruments are somewhat longer and should be regarded as violas. Violins with five strings or more are often used in jazz or folk music.

Bows

Bow frogs, top to bottom: violin, viola, cello

A violin is usually played using a bow consisting of a stick with a ribbon of horsehair strung between the tip and frog (or nut, or heel) at opposite ends. A typical violin bow may be 75 cm (29 inches) overall, and weigh about 60 g (2.1 oz). Viola bows may be about 5 mm (0.20 in) shorter and 10 g (0.35 oz) heavier.

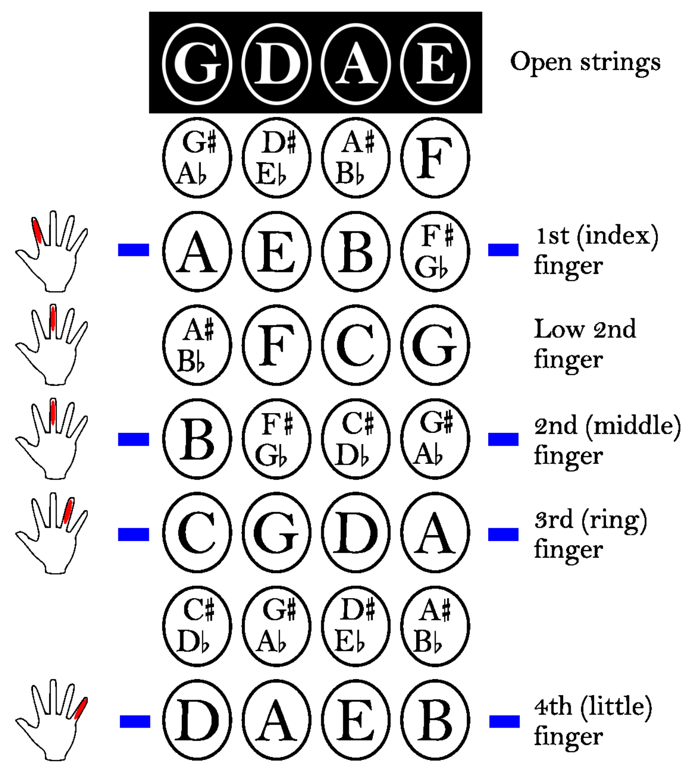
At the frog end, a screw adjuster tightens or loosens the hair. Just forward of the frog, a leather thumb cushion and winding protect the stick and provide a strong grip for the player's hand. The winding may be wire (often silver or plated silver), silk, or whalebone (now imitated by alternating strips of tan and black plastic.) Some student bows (particularly the ones made of solid fiberglass) substitute a plastic sleeve for grip and winding.

The hair of the bow traditionally comes from the tail of a grey male horse (which has predominantly white hair), though some cheaper bows use synthetic fiber. Occasional rubbing with rosin makes the hair grip the strings intermittently, causing them to vibrate. The stick is traditionally made of brazilwood, although a stick made from a more select quality (and more expensive) brazilwood is called pernambuco. Both types come from the same tree species. Some student bows are made of fiberglass or various inexpensive woods. Some recent bow design innovations use carbon fiber for the stick, at all levels of craftsmanship.

Playing

The standard way of holding the violin is with the left side of the jaw resting on the chinrest of the violin, and supported by the left shoulder, often assisted by a shoulder rest or a sponge and an elastic band for younger players who struggle with shoulder rests. This practice varies in some cultures; for instance, Indian (Carnatic and Hindustani) violinists play seated on the floor and rest the scroll of the instrument on the side of their foot. The strings may be sounded by drawing the hair of the bow across them *(arco)* or by plucking them *(pizzicato)*. The left hand regulates the sounding length of the string by stopping it against the fingerboard with the fingertips, producing different pitches.

Left hand and pitch production



First Position Fingerings

As the violin has no frets to stop the strings, the player must know exactly where to place the fingers on the strings to play with good intonation. Through practice and ear training, the violinist's left hand finds the notes intuitively by muscle memory. Beginners sometimes rely on tapes placed on the fingerboard for proper left hand finger placement, but usually abandon the tapes quickly as they advance. Another commonly used marking technique uses dots of white-out on the fingerboard, which wear off in a few weeks of regular practice. This practice, unfortunately, is used sometimes in lieu of adequate ear-training, guiding the placement of fingers by eye and not by ear. Especially in the early stages of learning to play, the so-called ringing tones are useful. There are nine such notes in first position, where a stopped note sounds a unison or octave with another (open) string, causing it to resonate sympathetically. Thus, "when unaccompanied, [a violinist] does not play consistently in either the tempered or the natural [just] scale, but tends on the whole to conform with the Pythagorean scale."[16]

The fingers are conventionally numbered 1 (index) through 4 (little finger). Especially in instructional editions of violin music, numbers over the notes may indicate which finger to use, with *0* indicating an open string. The chart to the right shows the arrangement of notes reachable in first position. Not shown on this chart is the way the spacing between note positions becomes closer as the fingers move up (in pitch) from the nut. The bars at the sides of the chart represent the usual possibilities for beginners' tape placements, at 1st, high 2nd, 3rd, and 4th fingers.

Positions

The placement of the left hand on the fingerboard is characterized by "positions". First position, where most beginners start (although some methods start in third position), is the most commonly used position in string music. The lowest note available in this position in standard tuning is an open G; the highest note in first position is played with the fourth finger on the E-string, sounding a B, or reaching up a half step (also known as the "extended fourth finger") to the C two octaves above middle C.

Moving the hand up the neck, so the first finger takes the place of the second finger, brings the player into *second position*. Letting the first finger take the first-position place of the third finger brings the player to *third position*, and so on. The upper limit of the violin's range is largely determined by the skill of the player, who may easily play more than two octaves on a single string, and four octaves on the instrument as a whole, although when a violinist has progressed to the point of being able to use the entire range of the instrument, references to particular positions become less common. Position names are mostly used for the lower positions and in method books; for this reason, it is uncommon to hear references to anything higher than seventh position. The lowest position on a violin is half-position, where the first finger is a half-step away from the nut. This position is less frequently used. The

highest position, practically speaking, is 15th position.

Moving between positions is called *shifting*. The player moves from position to position by typically using a guide finger. For example, when a player shifts from first to fourth position, they will use the last finger they used in first position as the guide finger. Then, the player moves their entire hand to fourth position, but with the last finger used in first position guiding the hand. The guide finger should not press on the string during the shift; it should only glide down the string. This guide finger moves to its respective spot in fourth position, but does not press down on the string. Then, the finger that plays the note after the shift should be pressed onto the string and the bow is moved to sound the note.

The same note may sound different, depending on which string is used to play it. Sometimes a composer or arranger specifies the string to use for a particular tone quality. This is indicated in the music by the marking, for example, *sul G*, meaning to play on the G string. For example, playing very high up on the lower strings gives a distinctive quality to the sound. Otherwise, moving into different positions is usually done for ease of playing.

Open strings

Bowing or plucking an *open string* (that is, a string played without any finger stopping it) gives a different sound from a stopped string, since the string vibrates more freely at the nut than under a finger. Other than the low G (which can be played in no other way), open strings are generally avoided in some styles of classical playing. This is because they have a somewhat harsher sound (especially open E) and it is not possible to directly use vibrato on an open string. However, this can be partially compensated by applying vibrato on a note that is an octave higher than the open string.

In some cases playing an open string is called for by the composer (and explicitly marked in the music) for special effect, decided upon by the musician for artistic reasons (common in earlier works such as Bach), or played in a fast passage, where they usually cannot be distinguished.

Playing an open string simultaneously with a stopped note on an adjacent string produces a bagpipe-like drone, often used by composers in imitation of folk music. Sometimes the two notes are identical (for instance, playing a fingered A on the D string against the open A string), giving a ringing sort of "fiddling" sound. Playing an open string simultaneously with an identical stopped note can also be called for when more volume is required, especially in orchestral playing.

Double stops and drones

Double stopping is when two separate strings are stopped by the fingers, and bowed simultaneously, producing a sixth, third, fifth, etc. harmony. Sometimes moving to a higher position is necessary for the left hand to be able to reach both notes at once. Sounding an open string alongside a fingered note is another way to get a partial chord. While sometimes also called a double stop, it is more properly called a drone, as the drone note may be sustained for a passage of different notes played on the adjacent string. Three or four notes can also be played at one time (triple and quadruple stops, respectively), and, according to the style of music, the notes might all be played simultaneously or might be played as two successive double stops, favoring the higher notes.

Vibrato

Kyoko Yonemoto playing Paganini's Caprice No. 24 on a violin

Vibrato is a technique of the left hand and arm in which the pitch of a note varies in a pulsating rhythm. While various parts of the hand or arm may be involved in the motion, the end result is a movement of the fingertip bringing about a slight change in vibrating string length. Some violinists oscillate backwards, or lower in pitch from the actual note when using vibrato, since it is believed that perception favors the highest pitch in a varying sound.[17] Vibrato does little, if anything, to disguise an out-of-tune note; in other words, misapplied vibrato is a poor substitute for good intonation. Scales and other exercises meant to work on intonation are typically played without vibrato to make the work easier and more effective. Music students are often taught that unless otherwise marked in music, vibrato is assumed or even mandatory. This can be an obstacle to a classically trained violinist wishing to play in a style that uses little or no vibrato at all, such as baroque music played in period style and many traditional fiddling styles.

Vibrato can be produced by a proper combination of finger, wrist and arm motions. One method, called *hand vibrato*, involves rocking the hand back at the wrist to achieve oscillation, while another method, *arm vibrato*, modulates the pitch by rocking at the elbow. A combination of these techniques allows a player to produce a large variety of tonal effects.

The "when" and "what for" of violin vibrato are artistic matters of style and taste. For example if you overdo the variation of the note's tone it may become very distracting and overwhelm the piece. In acoustic terms, the interest that vibrato adds to the sound has to do with the way that the overtone mix[18] (or tone color, or timbre) and the directional pattern of sound projection change with changes in pitch. By "pointing" the sound at different parts of the room[19] in a rhythmic way, vibrato adds a "shimmer" or "liveliness" to the sound of a well-made violin. Vibrato is, in a large part, left to the discretion of the violinist. Different types of vibrato will bring different moods to the piece, and the varying degrees and styles of vibrato are often characteristics that stand out in well-known violinists.

Vibrato trill

Vibrato can also be used for a fast trill. A trill initiated from just hammering the finger up and down on the fingerboard will create a harsher quality than with a vibrato trill. For example, if trilling on the first finger, the second finger is placed very slightly off the string and vibrato is implemented. The second finger will lightly touch the string above the first finger causing the pitch to change. This has a softer quality and many think it is nicer-sounding than a hammered trill. Note - this trill technique only works well for semi-tonal trills, it is far more difficult to vibrato trill for an interval of a tone or more.

Harmonics

Lightly touching the string with a fingertip at a harmonic node creates harmonics. Instead of the normal tone, a higher pitched note sounds. Each node is at an integer division of the string, for example half-way or one-third along the length of the string. A responsive instrument will sound numerous possible harmonic nodes along the length of the string. Harmonics are marked in music either with a little circle above the note that determines the pitch of the harmonic, or by diamond-shaped note heads. There are two types of harmonics: **natural harmonics** and **artificial harmonics** (also known as *false harmonics*).

Natural harmonics are played on an open string. The pitch of the open string is called the fundamental frequency. Harmonics are also called *overtones*. They occur at whole-number multiples of the fundamental, which is called the first harmonic. The second harmonic is the first overtone, the third harmonic is the second overtone, and so on. The second harmonic is in the middle of the string and sounds an octave higher than the string's pitch. The third harmonic

breaks the string into thirds and sounds an octave and a fifth above the fundamental, and the fourth harmonic breaks the string into quarters sounding two octaves above the first. The sound of the second harmonic is the clearest of them all, because it is a common node with all the succeeding even-numbered harmonics (4th, 6th, etc.). The third and succeeding odd-numbered harmonics are harder to play because they break the string into an odd number of vibrating parts and do not share as many nodes with other harmonics.

Artificial harmonics are more difficult to produce than natural harmonics, as they involve both stopping the string and playing a harmonic on the stopped note. Using the *octave frame* (the normal distance between the first and fourth fingers in any given position) with the fourth finger just touching the string a fourth higher than the stopped note produces the fourth harmonic, two octaves above the stopped note. Finger placement and pressure, as well as bow speed, pressure, and sounding point are all essential in getting the desired harmonic to sound. And to add to the challenge, in passages with different notes played as false harmonics, the distance between stopping finger and harmonic finger must constantly change, since the spacing between notes changes along the length of the string.

The *harmonic finger* can also touch at a major third above the pressed note (the fifth harmonic), or a fifth higher (a third harmonic). These harmonics are less commonly used; in the case of the major third, both the stopped note and touched note must be played slightly sharp otherwise the harmonic does not speak as readily. In the case of the fifth, the stretch is greater than is comfortable for many violinists. In the general repertoire fractions smaller than a sixth are not used. However, divisions up to an eighth are sometimes used and, given a good instrument and a skilled player, divisions as small as a twelfth are possible.

There are a few books dedicated solely to the study of violin harmonics. Two comprehensive works are Henryk Heller's seven-volume *Theory of Harmonics*, published by Simrock in 1928, and Michelangelo Abbado's five-volume *Tecnica dei suoni armonici* published by Ricordi in 1934.

Elaborate passages in artificial harmonics can be found in virtuoso violin literature, especially of the 19th and early 20th centuries. Two notable examples of this are an entire section of Vittorio Monti's *Csárdás* and a passage towards the middle of the third movement of Pyotr Ilyich Tchaikovsky's Violin Concerto.

Right hand and tone colour

The right arm, hand, and bow are responsible for tone quality, rhythm, dynamics, articulation, and most (but not all) changes in timbre.

Bowing techniques

The most essential part of bowing technique is the bow grip. It is usually with the thumb bent in the small area between the frog and the winding of the bow. The other fingers are spread somewhat evenly across the top part of the bow.

The violin produces louder notes with greater bow speed or more weight on the string. The two methods are not equivalent, because they produce different timbres; pressing down on the string tends to produce a harsher, more intense sound. One can also achieve a louder sound by placing the bow closer to the bridge.

The sounding point where the bow intersects the string also influences timbre. Playing close to the bridge (*sul ponticello*) gives a more intense sound than usual, emphasizing the higher harmonics; and playing with the bow over the end of the fingerboard (*sul tasto*) makes for a delicate, ethereal sound, emphasizing the fundamental frequency. Dr. Suzuki referred to the sounding point as the *Kreisler highway*; one may think of different sounding points as *lanes* in the highway.

Various methods of attack with the bow produce different articulations. There are many bowing techniques that allow for every range of playing style and many teachers, players, and orchestras spend a lot of time developing techniques and creating a unified technique within the group. These techniques include legato-style bowing, collé, ricochet, sautillé, martelé, spiccato, and staccato.

Pizzicato

A note marked *pizz.* (abbreviation for *pizzicato*) in the written music is to be played by plucking the string with a finger of the right hand rather than by bowing. (The index finger is most commonly used here.) Sometimes in virtuoso solo music where the bow hand is occupied (or for show-off effect), *left-hand pizzicato* will be indicated by a + (plus sign) below or above the note. In left-hand pizzicato, two fingers are put on the string; one (usually the index or middle finger) is put on the correct note, and the other (usually the ring finger or little finger) is put above the note. The higher finger then plucks the string while the lower one stays on, thus producing the correct pitch. By increasing the force of the pluck, one can increase the volume of the note that the string is producing.

Col legno

A marking of *col legno* (Italian for "with the wood") in the written music calls for striking the string(s) with the stick of the bow, rather than by drawing the hair of the bow across the strings. This bowing technique is somewhat rarely used, and results in a muted percussive sound. The eerie quality of a violin section playing *col legno* is exploited in some symphonic pieces, notably the "Witches' Dance" of the last movement of Berlioz's Symphonie Fantastique. Saint-Saens' symphonic poem "Danse Macabre" includes the string section using the *col legno* technique to imitate the sound of dancing skeletons. "Mars" from Gustav Holst's "The Planets" uses *col legno* to play a repeated rhythm in 5/4 time signature. Dmitri Shostakovich uses it in his Fourteenth Symphony in the movement 'At the Sante Jail'. Some violinists, however, object to this style of playing as it can damage the finish and impair the value of a fine bow.

Martelé

Literally *hammered*, a strongly accented effect produced by releasing each bowstroke forcefully and suddenly. Martelé can be played in any part of the bow. It is sometimes indicated in written music by an arrowhead.

Tremolo

Very rapid repetition (typically of a single note, but occasionally of multiple notes), usually played at the tip of the bow. Tremolo is marked with three short, slanted lines across the stem of the note.

Mute or sordino

Attaching a small metal, rubber, leather, or wooden device called a *mute*, or *sordino*, to the bridge of the violin gives a softer, more mellow tone, with fewer audible overtones; the sound of an entire orchestral string section playing with mutes has a hushed quality. The conventional Italian markings for mute usage are *con sord.*, or *con sordina*, meaning *with mute*; and *senza sord.*, meaning *without mute*; or *via sord.*, meaning *mute out*. Larger metal, rubber, or wooden mutes are widely available, known as *practice mutes* or *hotel mutes*. Such mutes are generally not used in performance, but are used to deaden the sound of the violin in practice areas such as hotel rooms. (For practicing purposes there is also the mute violin, a violin without a sound box.) Some composers have used practice mutes for special effect, for example at the end of Luciano Berio's *Sequenza VIII* for solo violin.

Musical styles

Classical music

Since the Baroque era, the violin has been one of the most important of all instruments in classical music, for several reasons. The tone of the violin stands out above other instruments, making it appropriate for playing a melody line. In the hands of a good player, the violin is extremely agile, and can execute rapid and difficult sequences of notes.

Violins make up a large part of an orchestra, and are usually divided into two sections, known as the first and second violins. Composers often assign the melody to the first violins, while second violins play harmony, accompaniment patterns or the melody an octave lower than the first violins. A string quartet similarly has parts for first and second violins, as well as a viola part, and a bass instrument, such as the cello or, rarely, the double bass.

Jazz

The earliest references to jazz performance using the violin as a solo instrument are documented during the first decades of the 20th century. Joe Venuti, one of the first jazz violinists, is known for his work with guitarist Eddie Lang during the 1920s. Since that time there have been many improvising violinists including Stéphane Grappelli, Stuff Smith, Regina Carter, Johnny Frigo, John Blake and Jean-Luc Ponty. While not primarily jazz violinists, Darol Anger and Mark O'Connor have spent significant parts of their careers playing jazz.

Violins also appear in ensembles supplying orchestral backgrounds to many jazz recordings.

Popular music

Up to the 1970s, most types of popular music used bowed strings. They were extensively used in popular music throughout the 1920s and early 1930s. There was a drastic decline in their use with the rise of swing music in 1935 as the string sound was deemed inappropriate to the improvised style of swing music. The late 1960s saw a revival of the use of strings with the rise of soul music. Popular Motown recordings of the late 1960s and 1970s relied heavily on strings as part of their trademark texture. The rise of disco music in the 1970s continued this trend with the heavy use of string instruments in popular disco orchestras (e.g. Love Unlimited Orchestra, Biddu Orchestra, Monster Orchestra, Salsoul Orchestra, MFSB, etc.).

The rise of electronically created music in the 1980s saw a decline in their use, as synthesized string sections took their place. However, while the violin has very little usage in rock music, it has some history in progressive rock (e.g., The Electric Light Orchestra, King Crimson, Kansas). The 1973 album *Contaminazione* by Italy's RDM plays violins off against synthesizers at its finale ("La grande fuga").

The instrument has a stronger place in modern fusion bands, notably The Corrs. The fiddle has also always been a part of British folk-rock music, as exemplified by the likes of Fairport Convention and Steeleye Span.

The popularity of crossover music beginning in the last years of the 20th century has brought the violin back into the popular music arena, with both electric and acoustic violins being used by popular bands. Vanessa Mae uses classical music with her electric violin. Dave Matthews Band features violinist Boyd Tinsley. The Flock featured violinist Jerry Goodman who later joined the jazz-rock fusion band, The Mahavishnu Orchestra. Yellowcard featured the instrument with a role equal to the guitar in many of their songs. Blue October are well-known for their violin-based Music with Master violinist Ryan Delahoussaye. James' Saul Davies, who is also a guitarist, was enlisted by the band as a violinist. For their first three albums and related singles, the British group No-Man made extensive use of electric and acoustic solo violin as played by band member Ben Coleman (who played violin exclusively).

Pop-Punk band Yellowcard has made a mainstay of violin in its music. Violinist Sean Mackin has been a member of the band since 1997. Los Salvadores also combine punk and ska influences with a violin.

Doom metal band My Dying Bride have used violin as a part of their line-up throughout many of their albums.

The violin appears prominently in the music of Spanish folk metal group Mägo de Oz, for example, in their 1998 hit "Molinos de viento". The violinist (Carlos Prieto aka "Mohamed") has been one of the group's most popular members with fans since 1992.

The alternative rock band Hurt's vocalist plays violin for the band, making them one of few rock bands to feature violin without hiring a session worker.

Independent artists such as Owen Pallett, The Shondes and Andrew Bird have also spurred increased interest in the instrument. Indie bands have often embraced new and unusual arrangements, allowing them more freedom to feature the violin than their mainstream brethren. It has been used in the post-rock genre by bands such as A Genuine Freakshow, Sigur Rós, Zox, Broken Social Scene, and A Silver Mt. Zion. The electric violin has even been used by bands like The Crüxshadows within the context of keyboard based music.

Indian, Pakistani, Turkish and Arabic pop music is filled with the sound of violins, both soloists and ensembles.

Indian classical music

The violin is a very important part of South Indian classical music (Carnatic music). It is believed to have been introduced to the South Indian tradition by Muthuswamy Dikshitar. Though primarily used as an accompaniment instrument, the violin has become popular as a solo instrument in the orchestration. Popular film composers such as Ilaiyaraaja have used the violin extensively in film music scoring. This type of music was often played on a harmonic scale.

Indian classical music uses a very different grip from the traditional European classical genre. The violin is held perpendicular to the chest with the scroll pointing down. Also, musicians play the instrument sitting squat on the floor and hence sometimes, the violin actually touches the floor. In its Indian classical form, the violin is also tuned differently.

Folk music and fiddling

Like many other instruments used in classical music, the violin descends from remote ancestors that were used for folk music. Following a stage of intensive development in the late Renaissance, largely in Italy, the violin had improved (in volume, tone, and agility), to the point that it not only became a very important instrument in art music, but proved highly appealing to folk musicians as well, ultimately spreading very widely, sometimes displacing earlier bowed instruments. Ethnomusicologists have observed its widespread use in Europe, Asia, and the Americas.

The fiddler Hins Anders Ersson painted by Anders Zorn, 1904

In many traditions of folk music, the tunes are not written but are memorized by successive generations of musicians and passed on, in what is known as the oral tradition.

Arabic music

As well as the Arabic rababah, the violin has been used in Arabic music.

Fiddle

When played as a folk instrument, the violin is ordinarily referred to in English as a *fiddle* (though the term *fiddle* may be used informally no matter what the genre of music). There is technically no difference between a fiddle and a violin. However, some folk fiddlers alter their instruments for various reasons. One example may be seen in American (e.g., bluegrass and old-time) fiddling: in these styles, the bridge is sometimes shaved down so that it is less curved. This makes it easier to play double stops and triple stops, allowing one to play chords with less effort. In addition, many fiddle players prefer to use a tailpiece with fine tuners on all four strings instead of only using one on the E string as many classical players do.

Electric violins


Acoustic and electric violin

Electric violins have a magnetic or piezoelectric pickup that converts string vibration to an electric signal. A cable or transmitter sends the signal to an amplifier. Electric violins are usually constructed as such, but a pickup can be added to a conventional acoustic violin.

An electric violin with a resonating body that produces listening-level sound independently of the electric elements can be called an *electro-acoustic violin*. To be effective as an acoustic violin, electro-acoustic violins retain much of the resonating body of the violin, often looking very much like, sometimes even identical to, an acoustic violin or fiddle. They may be finished in bright colours and made from alternative materials to wood. The first specially built electric violins date back to 1928 and were made by Victor Pfeil, Oskar Vierling, George Eisenberg, Benjamin Miessner, George Beauchamp, Hugo Benioff and Fredray Kislingbury. These violins can be played through many effects much like a guitar, such as distortion and delay.

Since electric violins do not rely on string tension and resonance to amplify their sound they can have more strings. For example five stringed electric violins are available from several manufacturers, and a seven string electric violin (with three lower strings encompassing the cello's range) is available.[20] The majority of the first electric violinists were musicians playing jazz and popular music.

Violin authentication

Violin authentication is the process of determining the maker and manufacture date of a violin. This process is similar to that used to determine the provenance of art works. As significant value may be attached to violins made either by specific makers or at specific times and locations, forgery and other methods of fraudulent misrepresentation can be used to inflate the value of an instrument.

Notes

[1] "Etymology of *viola*" (http://www.etymonline.com/index.php?search=viola&searchmode=none). Online Etymology Dictionary. . Retrieved 2008-09-26.

[2] "Etymology of *fiddle*" (http://www.etymonline.com/index.php?term=fiddle). Online Etymology Dictionary. . Retrieved 2010-12-03.

[3] "*The Silk Road: Connecting Cultures, Creating Trust*, Silk Road Story 2: Bowed Instruments" (http://www.silkroadproject.org/smithsonian/nomads/story.html). Smithsonian Center for Folk life and Cultural Heritage. . Retrieved 2008-09-26.

[4] Hoffman, Miles. "The NPR Classical Music Companion: Terms and Concepts from A to Z" (http://www.cso.org/main.taf?p=1,1,4,20). Chicago Symphony Orchestra. . Retrieved 2008-09-26.

[5] Grillet 1901, p. 29

[6] Margaret J. Kartomi: On Concepts and Classifications of Musical Instruments. Chicago Studies in Ethnomusicology, University of Chicago Press, 1990

[7] Panum, Hortense (1939). *The stringed instruments of the Middle Ages, their evolution and development*. London : William Reeves. p. 434.

[8] Arkenberg, Rebecca (October 2002). "Renaissance Violins" (http://www.metmuseum.org/toah/hd/renv/hd_renv.htm). Metropolitan Museum of Art. . Retrieved 2006-09-22.

[9] Deverich, Robin Kay (2006). "Historical Background of the Violin" (http://www.violinonline.com/historicalbackgroundoftheviolin.htm). ViolinOnline.com. . Retrieved 2006-09-22.

[10] Bartruff, William. "The History of the Violin" (http://web.archive.org/web/20070208112530/http://www.bartruff.com/history.php). Archived from the original (http://www.bartruff.com/history.php) on 2007-02-08. . Retrieved 2006-09-22.

[11] "Violin by Antonio Stradivari, 1716 (Messiah; la Messie, Salabue)" (http://www.cozio.com/Instrument.aspx?id=111). Cozio.com. . Retrieved 2008-09-26.

[12] Richard Perras. "Violin changes by 1800" (http://rperras.tripod.com/id42.htm). . Retrieved 2006-10-29.

[13] "Stradivarius violin sold for £9.8m at charity auction" (http://www.bbc.co.uk/news/entertainment-arts-13852872). BBC News. 2011-06-21. . Retrieved 2011-06-21.

[14] Piston, Walter (1955). *Orchestration*, p.45.

[15] Laird, Paul R.. "Carleen Maley Hutchins' Work With Saunders" (http://www.catgutacoustical.org/people/cmh/laird3.htm). Violin Society of America. . Retrieved 2008-09-26.

[16] Seashore, Carl (1938). *Psychology of Music*, 224. quote in Kolinski, Mieczyslaw (Summer - Autumn, 1959). "A New Equidistant 12-Tone Temperament", p.210, *Journal of the American Musicological Society*, Vol. 12, No. 2/3, pp. 210-214.

[17] Applebaum, Samuel (1957). *String Builder, Book 3: Teacher's Manual*. New York: Alfred Publishing. p. 4. ISBN 9780757930560.. "Now we will discipline the shaking of the left hand in the following manner: Shake the wrist slowly and evenly in 8th notes. Start from the original position and for the second 8th note the wrist is to move backward (toward the scroll). Do this in triplets, dotted 8ths and 16ths, and 16th notes. A week or two later, the vibrato may be started on the Violin. ... The procedure will be as follows: 1. Roll the finger tip from this upright position on the note, to slightly below the pitch of this note."

[18] Schleske, Martin. "The psychoacoustic secret of vibrato" (http://www.schleske.de/en/our-research/handbook-violinacoustics/vibrato-of-the-musician.html). . Retrieved 11 February 2010. "Accordingly, the sound level of each harmonic will have a periodically fluctuating value due to the vibrato."

[19] Curtin, Joseph (2000-04). "Weinreich and Directional Tone Colour" (http://www.josephcurtinstudios.com/news/strad/apr00/Gabi_strad.htm). *Strad Magazine*. . Retrieved 2009-05-23. "In the case of string instruments, however, not only are they strongly directional, but the pattern of their directionality changes very rapidly with frequency. If you think of that pattern at a given frequency as beacons of sound, like the quills of a porcupine, then even the slight changes in pitch created by vibrato can cause those quills to be continually undulating."

[20] "7String Violin Harlequin finish" (http://www.jordanmusic.com/V7harcom.htm). Jordan Music. . Retrieved 2009-02-27.

References

- *The Violin Forms of Antonio Stradivari*, by Stewart Pollens (1992), London: Peter Biddulph. ISBN 0-9520109-0-9
- *Principles of Violin Playing and Teaching*, by Ivan Galamian (1999), Shar Products Co. ISBN 0-9621416-3-1
- *The Contemporary Violin: Extended Performance Techniques*, by Patricia and Allen Strange (2001), University of California Press. ISBN 0-520-22409-4
- *The Violin: Its History and Making*, by Karl Roy (2006), ISBN ISBN 978-1-4243-0838-5
- *The Fiddle Book*, by Marion Thede (1970), Oak Publications. ISBN 0-8256-0145-2
- *Latin Violin*, by Sam Bardfeld, ISBN 0-9628467-7-5
- *The Cambridge Companion to the Violin*, edited by Robin Stowell (1992), Cambridge University Press. ISBN 0-521-39033-8
- *The Violin Explained - Components Mechanism and Sound* by James Beament (1992/1997), Clarendon Press. ISBN 0-19-816623-0
- *Antonio Stradivari, his life and work, 1644-1737', by William Henry Hill; Arthur F Hill; Alfred Ebsworth Hill (1902/1963), Dover Publications. 1963. OCLC 172278. ISBN 0-486-20425-1*
- *An Encyclopedia of the Violin*, by Alberto Bachmann (1965/1990), Da Capo Press. ISBN 0-306-80004-7
- *Violin - And Easy Guide*, by Chris Coetzee (2003), New Holland Publishers. ISBN 1-84330-332-9
- *The Violin*, by Yehudi Menuhin (1996), Flammarion. ISBN 2-08-013623-2
- *The Book of the Violin*, edited by Dominic Gill (1984), Phaidon. ISBN 0-7148-2286-8
- *Violin-Making as it was, and is*, by Ed. Heron-Allen (1885/1994), Ward Lock Limited. ISBN 0-7063-1045-4
- *Violins & Violinists*, by Franz Farga (1950), Rockliff Publishing Corporation Ltd.
- *Viols, Violins and Virginals*, by Jennifer A. Charlton (1985), Ashmolean Museum. ISBN 0-907849-44-X

- *The Violin*, by Theodore Rowland-Entwistle (1967/1974), Dover Publications. ISBN 0-340-05992-3
- *The Early Violin and Viola*, by Robin Stowell (2001), Cambridge University Press. ISBN 0-521-62555-6
- *The Complete Luthier's Library. A Useful International Critical Bibliography for the Maker and the Connoisseur of Stringed and Plucked Instruments* by Roberto Regazzi, Bologna: Florenus, 1990. ISBN 88-85250-01-7
- *The Violin*, by George Dubourg (1854), Robert Cocks & Co.
- *Violin Technique and Performance Practice in the Late 18th and Early 19th Centuries*, by Robin Stowell (1985), Cambridge University Press. ISBN 0-521-23279-1
- *History of the Violin*, by William Sandys and Simon Andrew (2006), Dover Publications. ISBN 0-486-45269-7
- *The Violin: A Research and Information Guide*, by Mark Katz (2006), Routledge. ISBN 0-8153-3637-3
- *Per gli occhi e 'l core. Strumenti musicali nell'arte* by Flavio Dassenno, (2004) a complete survey of the brescian school defined by the last researches and documents.
- Grillet, Laurent (1901). *Les ancetres du violon v.1*. Paris.

Further reading

- Templeton, David, *Fresh Prince: Joshua Bell on composition, hyperviolins, and the future* (http://www.stringsmagazine.com/issues/strings105/coverstory.html), Strings magazine, October 2002, No. 105.
- Young, Diana. *A Methodology for Investigation of Bowed String Performance Through Measurement of Violin Bowing Technique* (http://www.media.mit.edu/~young/publications/Young_Dissertation_2007.pdf). PhD Thesis. M.I.T., 2007.

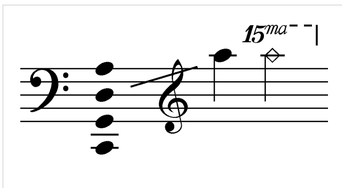
Cello

Cello

Cello, front and side view

String	
Other names	Violoncello
Hornbostel-Sachs classification	321.322-71 (Composite chordophone sounded by a bow)
Developed	about 1660 from the bass violin

Playing range



Related instruments

- **Violin family** (violin, viola)
- Viol family (includes double bass)

Musicians

- List of Cellists

The **cello** (pronounced English pronunciation: /ˈtʃɛloʊ/ ***chel**-oh*; plural **cellos** or **celli**) is a bowed string instrument with four strings tuned in perfect fifths. It is a member of the violin family of musical instruments, which also includes the violin, viola and the double bass. Old forms of the instrument in the Baroque era are baryton and viol (viola da gamba).

A person who plays a cello is called a cellist. The cello is used as a solo instrument, in chamber music, in a string orchestra and as a member of the string section of an orchestra. It is the second largest bowed string instrument in the modern symphony orchestra, the double bass being the largest.

Cellos were derived from other mid- to large-sized bowed instruments in the 16th century, such as the viola da gamba, and the generally smaller and squarer viola da braccio, and such instruments made by members of the Amati family of luthiers. The invention of wire-wrapped strings in Bologna gave the cello greater versatility. By the 18th century the cello had largely replaced other mid-sized bowed instruments.

Etymology

The name *cello* is an abbreviation of the Italian *violoncello*, which means "little violone", or referring to the violone ("big viol"), the lowest-pitched instrument of the viol family, the group of string instruments that went out of fashion around the end of the 17th century in most countries except France, where they survived another half-century or so before the louder violin family came into greater favour in that country too. Thus, the name carries both an augmentative *"-one"* ("big") and a diminutive *"-cello"* ("little"). By the turn of the 20th century, it had grown customary to abbreviate the name violoncello to 'cello, with the apostrophe indicating the six missing prefix letters.[1] It is now customary to use the name "cello" without the apostrophe and as a full designation.[1] The word derives ultimately from *vitula*, meaning a stringed instrument.

Description


Cello close-up

Cellos are tuned in fifths, starting with C2 (two octaves below middle C) as the lowest string, followed by G2, D3, and A3. It is tuned in same intervals as the viola, but an octave lower. Unlike the violin or viola but similar to the double bass, the cello has a endpin resting on the floor in order to support its heavy weight. The cellist Paul Tortelier is credited with inventing a bent pin, enabling the instrument to lie more horizontally than vertically.[2]

The cello is most closely associated with European classical music, and has been described as the closest sounding instrument to the male human voice.[3] The instrument is a part of the standard orchestra and is the bass voice of the string quartet, as well as being part of many other chamber groups. A large number of concertos and sonatas have been written for the cello.

Among the most well-known Baroque works for the cello are Johann Sebastian Bach's six unaccompanied Suites. The *Prelude* from the *First Suite* is particularly famous. From the Classical era, the two concertos by Joseph Haydn in C major and D major stand out, as do the five sonatas for cello and pianoforte of Ludwig van Beethoven, which span the important three periods of his compositional evolution. Romantic era repertoire includes the Robert Schumann Concerto, the Antonín Dvořák Concerto as well as the two sonatas and the Double Concerto by Johannes Brahms. Compositions from the early 20th century include Edward Elgar's Cello Concerto in E minor, Claude Debussy's Sonata for Cello and Piano and unaccompanied cello sonatas by Zoltán Kodály and Paul Hindemith. The cello's versatility made it popular with composers in the mid- to late 20th century such as Sergei Prokofiev, Dmitri Shostakovich, Benjamin Britten, György Ligeti and Henri Dutilleux, encouraged by soloists who specialized in contemporary music (such as Siegfried Palm and Mstislav Rostropovich) commissioning from and collaborating with composers.

Today the instrument is less common in popular music, but was commonly used in 1970's pop and disco music. Today it is still sometimes featured in pop and rock recordings, examples of which are noted later in this article. The cello has also recently appeared in major hip-hop and R & B performances, such as singers Rihanna and Ne-Yo's performance at the American Music Awards. The instrument has also been modified for Indian classical music by Nancy Lesh and Saskia Rao-de Haas.[4]

History

The history of bowed string musical instruments in Europe dates back to the 9th century with the *lira* (*Greek: λύρα, Latin: lūrā*), the bowed instrument of the Byzantine Empire, equivalent to the rabāb of the Islamic Empires. The Persian geographer Ibn Khurradadhbih (d. 911) of the 9th century, in his lexicographical discussion of instruments, cited the Byzantine lira as a typical instrument of the Byzantines along with the *urghun* (organ), *shilyani* (probably a type of harp or lyre) and the *salandj*.[5] The Byzantine lira spread through Europe westward and in the 11th and 12th centuries European writers use the terms *fiddle* and *lira* interchangeably when referring to bowed instruments (Encyclopædia Britannica. 2009). In the meantime the Arab rabāb was introduced to the Western Europe possibly through the Iberian Peninsula and both bowed instruments spread widely throughout Europe giving birth to various European bowed instruments.

Over the centuries that followed, Europe continued to have two distinct types of bowed instruments: one, relatively square-shaped, held in the arms, known with the Italian term **Lira da braccio** (or *Viola da braccio*, meaning *viol for the arm*), family of the modern violin; the other, with sloping shoulders and held between the knees, known with the Italian term **Lira da gamba** (or *viola da gamba*, meaning *viol for the leg*), family of the Byzantine lyra and the modern Cello.[6] During the Renaissance, the gambas were important and elegant instruments; they eventually lost ground to the louder (and originally less aristocratic) *lira da braccio*. However, the *a gamba* playing position remained popular to larger instruments that could not be played with *a braccio* position.

The violoncello da spalla (sometimes "violoncello piccolo da spalla" or "violoncello da span") was the first cello referred to in print (by Jambe de Fer in 1556).[1] "Violone" means a larger "viola" (viol), while "-cello" in Italian is a diminutive and spalla means "shoulder" in Italian so that violoncello da spalla suggest a "little big violin" that may be held on the shoulder so that the player could perform while walking or that the early, short-necked instrument was hung across the shoulder by a strap.[1]

Monteverdi referred to the instrument as "basso de viola da braccio" in *Orfeo* (1607). Although the first bass violin, possibly invented by Amati as early as 1538, was most likely inspired by the viol, it was created to be used in consorts with the violin. The bass violin was actually often referred to as a *"violone,"* or "large viola," as were the viols of the same period. Instruments that share features with both the bass violin and the *viola de gamba* appear in Italian art of the early 16th century.

The invention of wire-wound strings (fine wire around a thin gut core), around 1660 in Bologna, allowed for a finer bass sound than was possible with purely gut strings on such a short body. Bolognese makers exploited this new technology to create the cello, a somewhat smaller instrument suitable for solo repertoire due to both the timbre of the instrument and the fact that the smaller size made it easier to play virtuosic passages. This instrument had disadvantages as well, however. The cello's light sound was not as suitable for church and ensemble playing, so it had to be doubled by basses or violones.

Around 1700, Italian players popularized the cello in northern Europe, although the bass violin (basse de violon) continued to be used for another two decades in France. Many existing bass violins were literally cut down in size to convert them into cellos according to the smaller pattern developed by Stradivarius, who also made a number of old pattern large cellos (the 'Servais').[7] The bass violin remained the "most used" instrument in England as late as 1740, where the violoncello was still "not common."[8] The sizes, names, and tunings of the cello varied widely by geography and time.[7] The size was not standardized until around 1750.

Despite similarities to the viola da gamba, the cello is actually part of the viola da braccio family, meaning "viol of the arm," which includes, among others, the violin and viola. Though paintings like Bruegel's "The Rustic Wedding" and de Fer in his *Epitome Musical* suggest that the bass violin had alternate playing positions, these were short-lived and the more practical and ergonomic *a gamba* position eventually replaced them entirely.

Baroque era cellos differed from the modern instrument in several ways. The neck has a different form and angle, which matches the baroque bass-bar and stringing. Modern cellos have an endpin at the bottom to support the instrument (and transmit some of the sound through the floor), while Baroque cellos are held only by the calves of the player. Modern bows curve in and are held at the frog; Baroque bows curve out and are held closer to the bow's point of balance. Modern strings normally have a metal core, although some use a synthetic core; Baroque strings are made of gut, with the G and C strings wire-wound. Modern cellos often have fine-tuners connecting the strings to the tailpiece, which make it much easier to tune the instrument, but such pins are rendered ineffective by the flexibility of the gut strings used on Baroque cellos. Overall, the modern instrument has much higher string tension than the Baroque cello, resulting in a louder, more projecting tone, with fewer overtones.

A baroque cello strung with gut strings. Note the absence of fine-tuning pins on the tailpiece.

No educational works specifically devoted to the cello existed before the 18th century, and those that do exist contain little value to the performer beyond simple accounts of instrumental technique. The earliest cello manual is Michel Corrette's *Méthode, thèorique et pratique pour apprendre en peu de temps le violoncelle dans sa perfection* (Paris, 1741).

Current use

Orchestral

Cellos are part of the standard symphony orchestra, which usually includes eight to twelve players. The cello section, in standard orchestral seating, is located on stage left (the audience's right) in the front, opposite the first violin section. However, some orchestras and conductors prefer switching the positioning of the viola and cello sections. The *principal* cellist is the section leader, determining bowings for the section in conjunction with other string principals, and playing solos. Principal players always sit closest to the audience.

The cellos are a critical part of orchestral music; all symphonic works involve the cello section, and many pieces require cello soli or solos. Much of the time, cellos provide part of the harmony for the orchestra. On many occasions, the cello section will play the melody for a brief period of time, before returning to the harmony. There are also cello concertos, which are orchestral pieces in which a featured, solo cellist is accompanied by an entire orchestra.

Solo

There are numerous cello concertos - where a solo cello is accompanied by an orchestra - notably 25 by Vivaldi, 12 by Boccherini, 2 by Haydn, 3 by C.P.E. Bach, 2 by Saint-Saëns, 1 by Dvořák, and one each by Schumann, Lalo, and Elgar. Beethoven's Triple Concerto for Cello, Violin and Piano and Brahms' Double Concerto for Cello and Violin are also part of the concertante repertoire although in both cases the cello shares solo duties with at least one other instrument. Moreover, several composers wrote large-scale pieces for cello and orchestra, which are concertos in all but name. Some familiar "concertos" are Strauss' tone poem Don Quixote, Tchaikovsky's Variations on a Rococo Theme, Bloch's Schelomo and Bruch's Kol Nidrei.

In the 20th century, the cello repertoire grew immensely. This was partly due to the influence of virtuoso cellist Mstislav Rostropovich who inspired, commissioned and/or premiered dozens of new works. Among these, Prokofiev's *Symphonia Concertante*, Britten's *Cello Symphony* and the concertos of Shostakovich, Lutosławski and Dutilleux have already become part of the standard repertoire. Other major composers who wrote concertante works

for him include Messiaen, Berio and Penderecki. In addition, Hindemith, Barber, Honegger, Villa-Lobos, Myaskovsky, Walton, Glass, Rodrigo, Arnold, Penderecki and Ligeti also wrote major concertos for other cellists, notably for Gregor Piatigorsky, Siegfried Palm and Julian Lloyd Webber.

There are also many sonatas for cello and piano. Those written by Beethoven, Mendelssohn, Chopin, Brahms, Grieg, Rachmaninoff, Debussy, Fauré, Shostakovich, Prokofiev, Poulenc, Carter, and Britten are the most famous. Other important pieces for cello and piano include Schumann 's five *Stücke im Volkston* and transcriptions like Schubert's sonata in a minor (originally for arpeggione and piano), Stravinsky's *Suite Italienne* (transcribed by the composer from his ballet *Pulcinella*) and Bartók's first rhapsody (also transcribed by the composer, originally for violin and piano)

Finally, there are several pieces for cello solo, most importantly J.S. Bach's six Suites for Cello (arguably the most important cello pieces), Kodály's *Sonata for Solo Cello* and Britten's three Cello Suites. Other notable examples include Hindemith's and Ysaÿe's *Sonatas for Solo Cello*, Dutilleux' *Trois Strophes sur le Nom de Sacher*, Berio's *Les Mots Sont Allés* (both part of a series of twelve compositions for solo cello commissioned by Rostropovich for Swiss conductor Paul Sacher's 70th birthday), Cassado's "Suite for Solo Cello", Ligeti's *Sonata*, Carter's two *Figment*s and Xenakis' *Nomos Alpha* and *Kottos*.

Quartets and other ensembles

The cello is a member of the traditional string quartet as well as string quintets, sextet or trios and other mixed ensembles. There are also pieces written for two, three, four or more cellos; this type of ensemble is also called a "cello choir" and its sound is familiar from the introduction to Rossini's William Tell Overture as well as Zaccharias' prayer scene in Verdi's Nabucco. As a self-sufficient ensemble, its most famous repertoire is Villa-Lobos' first of his Bachianas Brasileiras for cello ensemble (the fifth is for soprano and 8 cellos). Other examples are Offenbach's cello duets, quartet, and sextet, Pärt's Fratres for 8 cellos and Boulez' *Messagesquisse* for 7 cellos, or even Villa-Lobos' rarely played *Fantasia Concertante* (1958) for 32 cellos. The Twelve Cellists of the Berlin Philharmonic Orchestra (or "the Twelve" as they have since taken to being called) specialize in this repertoire and have commissioned many works, including arrangements of well-known popular songs.

Popular music, jazz and neoclassical

Though the cello is less common in popular music than in classical music, it is sometimes featured in pop and rock recordings. The cello is rarely part of a group's standard lineup but like its cousin the violin it is becoming more common in mainstream pop (e.g. the baroque rock band Arcade Fire uses the cello in their songs).

In the 1960s, artists such as the Beatles and Cher used the cello in popular music, in songs such as "Bang Bang (My Baby Shot Me Down)", "Eleanor Rigby" and "Strawberry Fields Forever". Bass guitarist Jack Bruce, who had originally studied music on a performance scholarship for cello, played a prominent cello part in "As You Said" on Cream's *Wheels of Fire* studio album (1968). In the 1970s, the Electric Light Orchestra enjoyed great commercial success taking inspiration from so-called "Beatlesque" arrangements, adding the cello (and violin) to the standard rock combo line-up and in 1978 the UK based rock band, Colosseum II, collaborated with cellist Julian Lloyd Webber on the recording *Variations*. Most notably, Pink Floyd included a cello solo in their 1970 epic instrumental "Atom Heart Mother". Bass guitarist Mike Rutherford of Genesis was originally a cellist and included some cello parts in their *Foxtrot* album.

Established non-traditional cello groups include Apocalyptica, a group of Finnish cellists best known for their versions of Metallica songs, Rasputina, a group of cellists committed to an intricate cello style intermingled with Gothic music, Von Cello, a cello fronted rock power trio, Break of Reality who mix elements of classical music with the more modern rock and metal genre, and Jelloslave ([9]) a Minneapolis based Cello duo with two percussionists. These groups are examples of a style that has become known as cello rock. The crossover string quartet bond also includes a cellist. Silenzium and Vivacello are Russian (Novosibirsk) groups playing rock and metal and having

more and more popularity in Siberia. Cold Fairyland from Shanghai China is using a cello along a Pipa as the main solo instrument to create East meets West progressive (folk) rock.

More recent bands using the cello are Aerosmith, Nirvana, Oasis, Murder by Death, Cursive, A Genuine Freakshow, Smashing Pumpkins, James, and OneRepublic. An Atlanta-based trio, King Richard's Sunday Best, also uses a cellist in their lineup. So-called "chamber pop" artists like Kronos Quartet, The Vitamin String Quartet and Margot and the Nuclear So and So's have also recently made cello common in modern alternative rock. Heavy metal band System of a Down has also made use of the cello's rich sound. The indie rock band The Stiletto Formal are known for using a cello as a major staple of their sound, similarly, the indie rock band Canada employs two cello players in their lineup. The orch-rock group, The Polyphonic Spree, which has pioneered the use of stringed and symphonic instruments, employs the cello in very creative ways for many of their "psychedelic-esque" melodies. The first wave screamo band I Would Set Myself On Fire For You featured a cello as well as a viola to create a more folk-oriented sound. The band, Panic! At the Disco uses a cello in their song, "Build God, Then We'll Talk." The lead vocalist of the band, Brendon Urie, also did the recording of the cello solo.

In jazz, bassists Oscar Pettiford and Harry Babasin were among the first to use the cello as a solo instrument; both tuned their instrument in fourths, an octave above the double bass. Fred Katz (who was not a bassist) was one of the first notable jazz cellists to use the instrument's standard tuning and arco technique. Contemporary jazz cellists include Abdul Wadud, Diedre Murray, Ron Carter, Dave Holland, David Darling, Lucio Amanti, Akua Dixon, Ernst Reijseger, Fred Lonberg-Holm, Tom Cora, Vincent Courtois, Jean-Charles Capon, Erik Friedlander, and James Hinkley of jazz combo *Billet-Deux*.

Modern musical theatre pieces like Jason Robert Brown's The Last Five Years, Duncan Sheik's Spring Awakening, Adam Guettel's Floyd Collins, and Ricky Ian Gordon's My Life with Albertine use small string ensembles (including solo cellos) to a prominent extent.

The cello can also be used in bluegrass and folk music, with notable players including Ben Sollee of the Sparrow Quartet and the "Cajun cellist" Sean Grissom as well as Damien Rice. Lindsay Mac is becoming well known for playing the cello like a guitar, with her cover of The Beatles Blackbird a big hit on The Bob & Tom Show.

Construction

The cello is typically made from wood, although other materials such as carbon fibre or aluminum may be used. A traditional cello has a spruce top, with maple for the back, sides, and neck. Other woods, such as poplar or willow, are sometimes used for the back and sides. Less expensive cellos frequently have tops and backs made of laminated wood.

The top and back are traditionally hand-carved, though less expensive cellos are often machine-produced. The sides, or ribs, are made by heating the wood and bending it around forms. The cello body has a wide top bout, narrow middle formed by two C-bouts, and wide bottom bout, with the bridge and F holes just below the middle.

The top and back of the cello has decorative border inlay known as purfling. While purfling is attractive, it is also functional: if the instrument is struck, the purfling can prevent cracking of the wood. A crack may form at the rim of the instrument, but will spread no further. Without purfling, cracks can spread up or down the top or back. Playing, traveling and the weather all affect the cello and can increase a crack if purfling is not in place. Less expensive instruments typically have painted purfling.

Alternative materials

Cello manufacturer Luis & Clark constructs cellos from carbon fibre. Carbon fibre instruments are particularly suitable for outdoor playing because of the strength of the material and its resistance to humidity and temperature fluctuations. Luis & Clark has produced over 600 such cellos, some of which are owned by cellists such as Yo-Yo Ma[10] and Josephine van Lier.[11]

In the late 1920s and early 1930s, the Aluminum Company of America (Alcoa) as well as German luthier G.A. Pfretzschner produced an unknown number of aluminum cellos (in addition to aluminum double basses and violins). An advertisement published in N.Y. Music Service catalogue (1930) reads: "...made entirely of aluminum with the exception of the fingerboard. They have many advantages over the wood basses and violoncellos, as they cannot crack, split or warp and are made to last forever ... possessing a tone quality that is deep, resonant and responsive to the utmost degree. Violoncello $150." Only a handful of aluminum cellos exist today including a Pfretzschner played by modern classical cellist Frances-Marie Uitti, another played by bluegrass cellist Stan Young.

Neck, pegbox, and scroll

Above the main body is the carved neck, which leads to a pegbox and the scroll. The neck, pegbox, and scroll are normally carved out of a single piece of wood. Attached to the neck and extending over the body of the instrument is the fingerboard. The nut is a raised piece of wood, where the fingerboard meets the pegbox, which the strings rest on. The pegbox houses four tuning pegs, one for each string. The pegs are used to tune the cello by either tightening or loosening the string. The scroll is a traditional part of the cello and all other members of the violin family. Ebony is usually used for the tuning pegs, fingerboard, and nut, but other hard woods, such as boxwood or rosewood, can be used.

Strings

Strings on a cello have cores made out of gut (sheep or goat), metal, or synthetic materials, such as Perlon. Most modern strings used today are also wound with metallic materials like aluminum, titanium and chromium. Cellists may mix different types of strings on their instruments. The pitches of the open strings are C, G, D, and A (black note heads in the playing range figure above), unless alternative tuning (scordatura) is used.

Tailpiece and endpin

The tailpiece and endpin are found in the lower part of the cello. The tailpiece is traditionally made of ebony or another hard wood, but can also be made of plastic or steel. It attaches the strings to the lower end of the cello, and can have one or more fine tuners. The endpin or spike is made of wood, metal or rigid carbon fibre and supports the cello in playing position. In the Baroque period the cello was held between the calves. Around the 1830s, the Belgian cellist Auguste Adrien Servais introduced the endpin and propagated its use. Modern endpins are retractable and adjustable; older ones were removed when not in use. (The word "endpin" sometimes also refers to the button of wood located at this place in all instruments in the violin family, but this is usually called "tailpin".[12]) The sharp tip of the cello's endpin is sometimes capped with a rubber tip that protects the tip from dulling and prevents the cello from slipping on the floor.

Bridge and f-holes

The bridge of a cello, with a mute (the mute is not in use)

The bridge holds the strings above the cello and transfers their vibrations to the top of the instrument and the soundpost inside (see below). The bridge is not glued, but rather held in place by the tension of the strings. The f-holes, named for their shape, are located on either side of the bridge, and allow air to move in and out of the instrument as part of the sound-production process. The f-holes also act as access points to the interior of the cello for repairs or maintenance. Sometimes a small hose containing a water-soaked sponge, called a Dampit, is inserted through the f-holes, and serves as a humidifier.

Internal features

Internally, the cello has two important features: a bass bar, which is glued to the underside of the top of the instrument, and a round wooden sound post, which is wedged between the top and bottom plates. The bass bar, found under the bass foot of the bridge, serves to support the cello's top and distribute the vibrations. The sound post, found under the treble side of the bridge, connects the back and front of the cello. Like the bridge, the sound post is not glued, but is kept in place by the tensions of the bridge and strings. Together, the bass bar and sound post transfer the strings' vibrations to the top (front) of the instrument (and to a lesser extent the back), acting as a diaphragm to produce the instrument's sound.

Glue

Cellos are constructed and repaired using hide glue, which is strong but reversible, allowing for disassembly when needed. Tops may be glued on with diluted glue, since some repairs call for the removal of the top. Theoretically, hide glue is weaker than the body's wood, so as the top or back shrinks side-to-side, the glue holding it will let go, avoiding a crack in the plate.

Bow


A cello French bow held with the palm facing down,[13] *sul ponticello*

Traditionally, bows are made from pernambuco or brazilwood. Both come from the same species of tree (*Caesalpina echinata*), but pernambuco, used for higher-quality bows, is the heartwood of the tree and is darker in color than brazilwood (which is sometimes stained to compensate). Pernambuco is a heavy, resinous wood with great elasticity, which makes it an ideal wood for instrument bows.

Bows are also made from other materials, such as carbon-fibre—stronger than wood—and fiberglass (often used to make inexpensive, low-quality student bows). An average cello bow is 73 cm long (shorter than a violin or viola bow) 3 cm high (from the frog to the stick) and 1.5 cm wide. The frog of a cello bow typically has a rounded corner like that of a viola bow, but is wider. A cello bow is roughly 10 grams heavier than a viola bow, which in turn is roughly 10 grams heavier than a violin bow.

Bow hair is traditionally horsehair, though synthetic hair, in varying colors, is also used. Prior to playing, the musician tightens the bow by turning a screw to pull the frog (the part of the bow under the hand) back, and increase the tension of the hair. Rosin is applied by the player to make the hairs sticky. Bows need to be re-haired periodically.

Baroque style (1600–1750) cello bows were much thicker and were formed with a larger outward arch when compared to modern cello bows. The inward arch of a modern cello bow produces greater tension, which in turn gives off a louder sound.

The cello bow, though not made conventionally for the use, has also been used to play guitars. The post-rock Icelandic band Sigur Rós' lead singer often plays a guitar using a cello bow, as did Jimmy Page on tracks such as "Dazed and Confused".

Physics

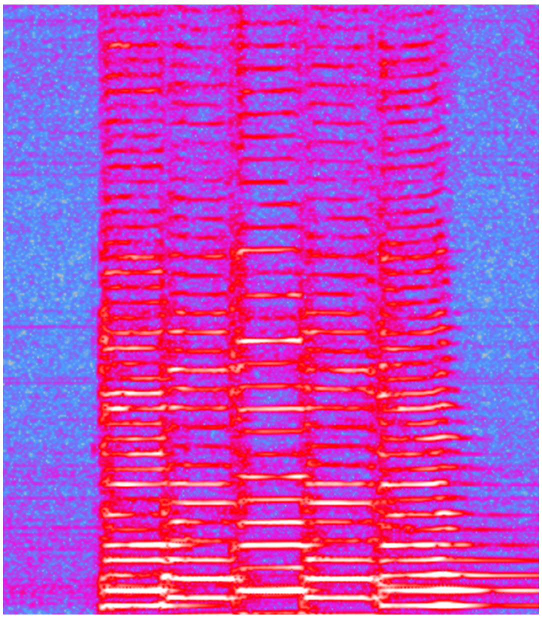
Physical Aspects

When a string is bowed or plucked, it vibrates, or moves the air around it, producing sound waves. Because the string is quite thin, not as much air is moved, and consequently the sound is weak. In acoustic stringed instruments such as the cello, this lack of volume is solved by mounting the vibrating string on a larger body. The vibrations are transmitted to the larger body, which can move more air and produce a louder sound. The design of the instrument produces variations in the instrument's vibrational patterns and thus changes the character of the sound produced.[14]

A string's fundamental pitch can be adjusted by changing its stiffness, which depends on tension and length. Tightening a string stiffens it by increasing both the outward forces along its length and the net forces it experiences during a distortion.[15] A cello can be tuned by adjusting the tension in its strings using pegs in its neck and tension adjusters (fine tuners) on the tail piece.

A string's length also affects its fundamental pitch. Shortening a string stiffens it by increasing its curvature during a distortion and subjecting it to larger net forces. Shortening the string also reduces its mass. Since a stiffer string with a smaller mass vibrates faster, shortening a string increases the pitch. Because of this effect, you can raise and change the pitch of a string by pressing it against the fingerboard in the cello's neck and effectively shortening it.[15]

Subjective Aspects

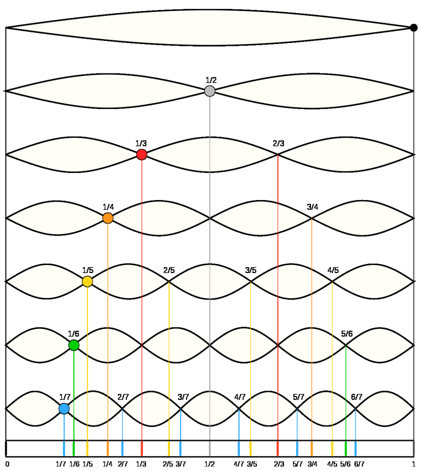


Spectogram of a D chord arpeggiated on the cello. Yellow bands at the same level indicate the same harmonics excited by the bowing of different notes. Notes played from left to right: D F# A F# D.

When a string is bowed or plucked to produce a note, the note is accompanied by other higher, resonant frequencies. You actually hear a superposition of these frequencies. The reason you can distinguish among the sources is that each sound has a unique combination of intensities of the various harmonics. One sound might be composed of a strong fundamental frequency and weaker higher harmonics, and another may have a particularly strong second harmonic. Each sound has a particular recipe of resonant frequencies that combine to make the total sound.[16]

For the cello, the main wood resonance generally appears very close to the note F#$_2$, often with serious consequences. When the cellist plays the note F#$_2$, the main wood resonance vibrates at its frequency as the cello sounds the frequency of the note F#$_2$. A loud beating sound results between these nearby frequencies; this is known as the "wolf tone" because it is an unpleasant growling sound. The wood resonance appears to be split into two frequencies by the driving force of the sounding string. These two periodic resonances beat with each other. This wolf tone must be eliminated or significantly reduced for the cello to play the nearby notes with a pleasant tone. This can be accomplished by modifying the cello front plate, attaching a wolf eliminator, or moving the sound post.[17]

Harmonics



The modes of a vibrating cello string are harmonics.

A vibrating string subdivides itself into many parts vibrating at the same time. Each part produces a pitch of its own, called a partial. A vibrating string has one fundamental and a series of partials. The most pure combination of two pitches is when one is double the frequency of the other.[17]

For a repeating wave, the velocity, v, equals the wavelength, λ, times the frequency, f. $v = \lambda f$ On a cello string, waves reflect from both ends. The superposition of reflecting waves results in a standing wave pattern, but only for wavelengths $\lambda = 2L, L, L/2, \ldots = 2L/n$, where L is the length of the string. Therefore the only frequencies produced on a single string are $f = nv/(2L)$. Timbre is largely determined by the content of these harmonics. Different instruments have different harmonic content for the same pitch. A real string vibrates at harmonics that are not

perfect multiples of the fundamental. This results in a little in-harmonicity, which gives richness to the tone and covers up slight de-tunings of different notes in a chord.[18]

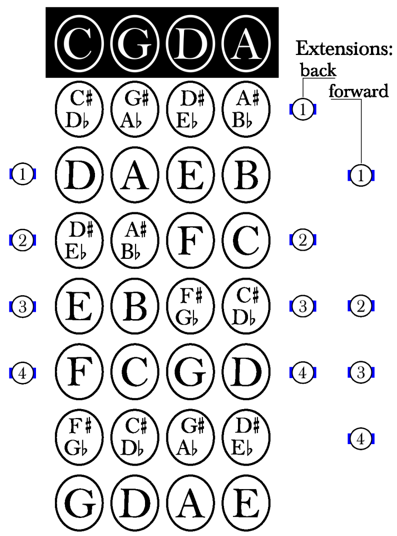
Playing technique

Body position

The cello is played while seated. Its weight is supported mainly by its endpin or spike, which rests on the floor.[19] The cello is steadied on the lower bout between the knees of the seated player, and on the upper bout against the upper chest. The neck of the cello is above the player's left shoulder, and the C-String tuning peg is just behind the left ear. The bow is drawn horizontally across the strings. In early times, female cellists sometimes played side-saddle, since it was considered improper for a lady to part her knees in public. A player's handedness does not alter the way the cello is held or used. In rare cases, a player has used a mirror-image posture—usually because of a physical disability of the arm or hand that makes the required technique impossible for that side of the body. In such a situation, the player must decide whether or not to reverse the set-up of the cello (the string positions, bass-bar, sound post, fingerboard shape, and bridge carving are all asymmetrical).

Left hand technique

The left hand fingertips stop the strings along their length, determining the pitch of each fingered note. Stopping the string closer to the bridge results in higher-pitched sound, because the vibrating string length has been shortened. In the *neck* positions (which use just less than half of the fingerboard, nearest the top of the instrument), the thumb rests on the back of the neck; in *thumb position* (a general name for notes on the remainder of the fingerboard) the thumb usually rests alongside the fingers on the string and the side of the thumb is used to play notes. The fingers are normally held curved with each knuckle bent, with the fingertips in contact with the string. If a finger is required on two (or more) strings at once to play perfect fifths (in double stops or chords) it is used flat. In slower, or more expressive playing, the contact point can move slightly away from the nail to the pad of the finger, allowing a fuller vibrato.



Cello first position fingering chart.

Vibrato

Vibrato is a small oscillation in the pitch of a note, usually considered expressive. It is not created by an upper arm motion; rather, it is more of forearm motion. The fixed point of contact of the fingertip on the string absorbs this motion by rocking back and forth. This change in the attitude of the fingertip to the string varies the pitch. Since vibrato is usually considered a key expressive device, a well-developed vibrato technique is an essential element of a modern cellist's skill. In some styles of music, such as that of the Romantic period, vibrato may be used on almost every note. However, in other styles, such as Baroque repertoire, vibrato is used only rarely, as an ornament. In any case, the choice of whether to use vibrato, and how much, is normally a stylistic decision on the part of the player. Typically, the lower the pitch of the note played, the wider and slower the vibrato.

Harmonics

Harmonics played on the cello fall into two classes; natural and artificial. Natural harmonics are produced by lightly touching (but not depressing) the string with the finger at certain places, and then bowing (or, rarely, plucking) the string. For example, the halfway point of the string will produce a harmonic that is one octave above the unfingered (open) string. Natural harmonics only produce notes that are part of the harmonic series on a particular string. Artificial harmonics (also called false harmonics or stopped harmonics), in which the player depresses the string fully with one finger while touching the same string lightly with another finger, can produce any note above middle C. They usually appear with the touching note a perfect fourth above the stopped note, which produces a sound two octaves above the stopped note, although other intervals are available. All harmonics produce a distinctive flute-like sound, and are usually performed without vibrato.

Glissando

Glissando (Italian for "sliding") is an effect played by sliding the finger up or down the fingerboard without releasing the string. This causes the pitch to rise and fall smoothly, without separate, discernible steps.

Right hand technique

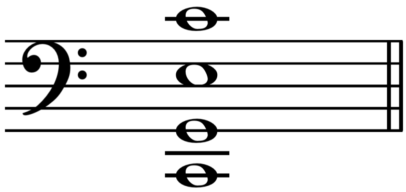
In cello playing, the bow is much like the breath of a wind instrument player. Arguably, it is the major determinant in the expressiveness of the playing. The right hand holds the bow and controls the duration and character of the notes. The bow is drawn across the strings roughly halfway between the end of the fingerboard and the bridge, in a direction perpendicular to the strings. The bow is held with all five fingers of the right hand, the thumb opposite the fingers and closer to the cellist's body. The shape of the hand should resemble that of its relaxed state, with all fingers curved, including the thumb. The transmission of weight from the arm to the bow happens through the pronation (inward rotation) of the forearm, which pushes the index finger and to a lesser degree the middle finger onto the bow. The necessary counterforce is provided by the thumb. Depending upon the school of training, the other two fingers are used in various degrees to help maintain the angle of the bow to the string and are critical to controlling the bow when it is off the string. (See also spiccato).

In English, the terminology for bow direction (*up* and *down*) can be misleading. A downbow is drawn to the right of the player, and an upbow to the left. A downbow is drawn by first using the upper arm, then the forearm, then the wrist (turning slightly inward) to maintain a straight stroke. An upbow is drawn by moving first the forearm, then the upper arm, then the wrist (pushing slightly upward). The bow is mostly used perpendicular to the strings. To perform string changes the whole arm is either lowered or lifted, with as little wrist movement as possible to maintain the angle to the string. However, flexibility of the wrist is necessary when changing the bow direction from up-bow to down-bow and vice versa. For very fast bow movements, the wrist is used to accomplish the horizontal movement of the bow. For longer strokes, the arm is used as well as the wrist.

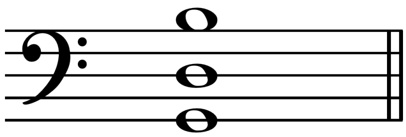
Tone production and volume of sound depend on a combination of several factors. The three most important ones are: bow speed, weight applied to the string, and point of contact of the bow hair with the string. A good player will be capable of a very even tone, and will counter the natural tendency to play with the most force with the part of the bow nearest to the frog or heel, and the least force near the tip. The closer to the bridge the string is bowed, the more projecting and brighter the tone, with the extreme (*sul ponticello*) producing a metallic, shimmery sound. If bowing closer to the fingerboard (*sul tasto*), the sound produced will be softer, more mellow, and less defined.

Double stops

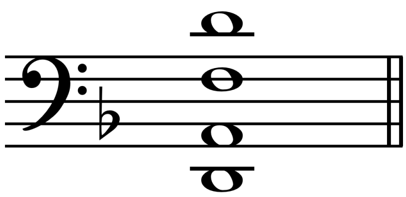
Double stops involve the playing of two notes at the same time. Two strings are fingered simultaneously, and the bow is drawn so as to sound them both at once. Triple and quadruple stops may also be played (in a "broken" fashion), but are difficult to sustain because of the change in slope of the bridge. To extend the technique in this area, Frances-Marie Uitti has invented a two-bow system: one bow plays above the strings and one below, allowing for sustained triple and quadruple stops. However, this technique is very rarely seen or used.



Violoncello chord on C major Play.



Violoncello chord on G Play.



Violoncello chord on D minor Play.

Pizzicato

In pizzicato playing, the string is plucked directly with the fingers or thumb. Position of the hand is slightly over the finger board and away from the bridge. Usually this is done with the right hand, while the bow is held away from the strings by the rest of the hand or (for extended passages) set down. A single string can be played *pizzicato,* or double, triple, or quadruple stops can be played. Occasionally, a player must bow one string with the right hand and simultaneously pluck another with the left. This is marked by a "+" above the note. Strumming of chords is also possible, in guitar fashion.

Col legno

A player using the Col legno technique rubs the strings with the wood of the bow rather than the hair. There are two forms, *col legno battuto* and *col legno tratto*. *Col legno battuto* is performed as a percussive technique with no sustaining of the sound. The much less common alternative is *col legno tratto*, wherein the wood is drawn across the string as the hair is in a normal bow stroke. Some players refuse to use this technique because of potential damage to the bow.

Spiccato

In spiccato playing, the strings are not "drawn" by the bow hair but struck by it, while still retaining some horizontal motion, to generate a more percussive, crisp sound. It may be performed by using the wrist to "dip" the bow into the strings. Spiccato is usually associated with lively playing. On a violin, *spiccato* bowing comes off the string, but on a cello, the wood of the bow may rise briskly up without the hair actually leaving the string. While playing spiccato, the bow is literally bouncing off the string. Cello players simply "dip" the bow into the string, and touch it very fast, and then lift the bow off the string.

Staccato

In staccato, the player moves the bow a small distance and stops it on the string, making a short sound, the rest of the written duration being taken up by silence.

Legato

Legato is a technique where the notes are smoothly connected without accents or breaks.

Sul ponticello/sul tasto

Sul ponticello ("on the bridge") refers to bowing closer to the bridge, while *sul tasto* ("on the fingerboard") calls for bowing nearer the end of the fingerboard. (While reading music, "tasto" can also mean to play with the bow in normal postiton when having been playing "ponticello") Ponticello calls for more bow weight and slower bow speed, and produces a "harder" sound, with strong overtone content. Sul tasto, in extreme cases called "flautando," produces a more flute-like sound, with more emphasis on the fundamental frequency of the note, and softer overtones.

Sul tasto

Con/Senza sord.

This refers to using a mute, or sordino, which is placed on the bridge to mellow or soften the tone, or to take it off.

Sizes

1/8 size cello with full size cello

Standard-sized cellos are referred to as "full-size". However, cellos come in smaller (fractional) sizes, from "7/8" and "3/4" down to "1/16" sized cellos (e.g. 7/8, 3/4, 1/2, 1/4, 1/8, 1/10, 1/16). The smaller-sized cellos are identical to standard cellos in construction, range, and usage, but are simply 'scaled-down' for the benefit of children and shorter adults. Note that a "half-size" cello is half the volume of a full-size, not half the length (i.e., the 1/8-size cello would be "half-size" in terms of length). A 1/10-size cello, for example, which is meant to be used by small children, is only slightly larger than a violin (and as such can be played by an adult player like one), but about twice as thick, and the C string tends to be quite slack due to the difficulty for such a small string to produce a sound that low. Many smaller cellists prefer to play a "7/8" cello as the hand stretches in the lower positions are less demanding. Although rare, cellos in sizes larger than 4/4 do exist. Cellists with unusually large hands may play a slightly larger than full-sized cello. Cellos made before approximately 1700 tended to be considerably larger than those made and commonly played today.

Around 1680, string-making technology made lower pitches on shorter strings possible. The cellos of Stradivari, for example, can be clearly divided into two models, the style made before 1702 characterized by larger instruments (of which only three exist in their original size and configuration), and the style made during and after 1702, when Stradivari, presumably in response to the "new" strings, began making smaller cellos. This later model is the one

most commonly used by modern luthiers.

Approximate dimensions for 4/4 size cello[20]	Average size (cm)	Average size (in)
Approximate width horizontally from A peg to C peg ends	16	6 - 5/16
Back length excluding half round where neck joins	75.5	29 - 3/4
Upper bouts (shoulders)	34	13 - 3/8
Lower bouts (hips)	44	17 - 3/8
Bridge height	9	3 - 9/16
Rib depth at shoulders including edges of front and back	12.5	4 - 15/16
Rib depth at hips including edges	12.8	5 - 1/16
Distance beneath fingerboard to surface of belly at neck join	2.2	7/8
Bridge to back total depth	26.7	10 - 1/2
Overall height excluding end pin	121	47 - 10/16
End pin unit and spike	5.5	2 - 5/8

Accessories

There are many accessories for the cello.

- Cases are used to protect the cello and bow (or multiple bows) when traveling and for safe storage. They are often made of carbon fiber, fiber-glass, and less commonly wood.
- Rosin, made from conifer resin, is applied to the bow hairs to increase the effectiveness of the friction, grip or bite, and allow proper sound production. Rosin may have additives to modify the friction such as beeswax, gold, silver or tin. Commonly, rosins are classified as either Dark or Light. Dark rosins increase the friction more than Light rosins.
- Endpin stops or straps (tradenames include Rockstop and Black Hole) keep the cello from sliding if the end pin does not have a rubber piece on the end (used on wood floors) though in many cases a rubber piece will not suffice on even a wood floor. Many Cellists often use a square or rectangle of carpet that can be secured under the front two legs of the chair as an endpin stop. This is however less likely to be seen in a professional arena and more used in rehearsal or in private.
- Wolf tone eliminators are often placed on cello strings between the tailpiece and the bridge to eliminate acoustic anomalies known as wolf tones or "wolfs".
- Mutes are used to change the sound of the cello by reducing overtones. Practice mutes (made of metal) significantly reduce the instrument's volume (they are also referred to as "hotel mutes"). The most common mute is a rubber disc with two holes to fit the two middle strings. It sits just after the bridge and has a flap that can be placed over the top of the bridge to mute the vibrations travelling down it to the sound post inside the cello. These are especially used due to their simplicity and can be taken off or put on very quickly because they can be stored on the strings past the bridge.
- Metronomes provide a steady tempo by sounding out a certain number of beats per minute. They are adjustable to fit the tempo of the piece. Many models can also produce a tuning pitch of A4 (440 Hz), among others. These can, of course, be used for all instruments.
- Humidifiers are used to control and stabilize the humidity around and inside the cello and are popular with traveling cellists. Often, these are placed inside the cello itself or inside the case. Some players will not use humidifiers inside their cellos because they have the potential to drip, which may cause damage to the cello.
- Electronic tuners are sometimes used to tune the instrument. A tuner indicates if a played note is sharp or flat.

Instrument makers

Cellos are made by luthiers, specialists in building and repairing stringed instruments, ranging from guitars to violins. The following luthiers are notable for the cellos they have produced:

- Nicolò Amati and others in the Amati family
- William Forster
- Nicolò Gagliano
- Matteo Goffriller
- Giovanni Battista Guadagnini
- Giuseppe Guarneri
- Domenico Montagnana
- Giovanni Battista Rogeri
- Francesco Ruggieri
- Stefano Scarampella
- Antonio Stradivari
- David Tecchler
- Carlo Giuseppe Testore
- Jean Baptiste Vuillaume

Cellists

A person who plays the cello is called a *cellist*. For a list of notable cellists, see the list of cellists and Category:Cellists.

Famous cellos

Specific instruments are, or become, famous, for a variety of reasons. An instrument's notability may arise from its age, the fame of its maker, its physical appearance, its acoustic properties, and its use by notable performers. The most famous instruments are generally known for all of these things. The most highly prized instruments are now collector's items, and are priced beyond the reach of most musicians. These instruments are typically owned by some kind of organization or investment group, which loans the instrument to a performer. (For example, the Davidov Stradivarius, which is currently in the possession of one of the most widely known living cellists, Yo-Yo Ma, is actually owned by the Vuitton Foundation.[21])

Some notable cellos:

- the "King", by Andrea Amati, is one of the oldest known cellos, built between 1538 and 1560. It is in the collection of the National Music Museum in South Dakota.[22]
- Servais Stradivarius is in the collection of the Smithsonian Institution, Washington DC
- Davidov Stradivarius, played by Jacqueline du Pré, currently played by Yo-Yo Ma
- Barjansky Stradivarius, played by Julian Lloyd Webber
- Bonjour Stradivarius, played by Soo Bae
- Paganini-Ladenburg Stradivarius, played by Clive Greensmith of the Tokyo String Quartet
- Duport Stradivarius, until recently played by the late Mstislav Rostropovich
- Piatti Stradivarius, 1720, played by Carlos Prieto

Notes

[1] Delbanco, Nicholas. (January 1, 2001) Harper's Bazaar. *The Countess of Stanlein Restored. (Violoncello owned by [[Bernard Greenhouse* (http://www.encyclopedia.com/doc/1G1-70397117.html)*] is restored).]* Volume 302; Issue 1808; Page 39.

[2] http://www.paulperleycellos.com/chatterfurthertonalimprovements.html

[3] Welcome::. to Academic Journals Inc (http://www.academicjournals.net/2/detail.php?id=2&jid=ajcb&theme=2&issueno=4&articleno=17#)

[4] "Cellist Saskia Rao-de Haas" (http://www.saskiarao.com/). . Retrieved 2/12 2009.

[5] Margaret J. Kartomi: On Concepts and Classifications of Musical Instruments. Chicago Studies in Ethnomusicology, University of Chicago Press, 1990

[6] stringed instrument. (2009). In Encyclopædia Britannica. Retrieved March 14, 2009, from Encyclopædia Britannica Online: http://www.britannica.com/EBchecked/topic/569200/stringed-instrument (Encyclopædia Britannica. 2009)

[7] Cyr 1982

[8] Grassineau 1740

[9] http://www.jelloslave.com

[10] stringed instrument. (2009). In Encyclopædia Britannica. Retrieved May 23, 2009, from The New York Times Online: http://www.nytimes.com/2009/01/19/arts/music/19carb.html (NY Times. Jan. 18, 2009 "The Sound of Carbon for Yo-Yo Ma?" by Chris Museler)

[11] LUIS AND CLARK Carbon Fibre Cello: http://www.albertastringassociation.ca/Newsletter/Summer%202006/ASA%20Newsletter%20Summer%202006.pdf

[12] http://www.britannica.com/EBchecked/topic/569200/stringed-instrument

[13] as opposed to the German bow popular in baroque era, held underhand File:Lute-viol ABosse Fr 1635.jpg File:Viol Abel TGainsborough1765.jpg(*see* Viol) used commonly today with the double bass

[14] Cowling, Elizabeth. The Cello. New Edition. Charles Scribner's Sons. 1975. ISBN 0684178702. pp 1 – 50

[15] Bloomfield, Louis A. How Things Work: The Physics of Everyday Life. Second Edition. John Wiley & Sons, Inc. 2001. ISBN 0471381519. pp 241-244

[16] Chattopadhyay, D. Elements of Physics, Volume 1. New Age International Publishers, 2004. ISBN 9788122415384. pp. 318, 319, 321

[17] Berg, Richard E. Stork, David G. The Physics of Sound. Third edition. Pearson Education, Inc. 2005. ISBN 0131457896. pp 314, 329-330.

[18] Physics of the Piano by the Piano Tuners Guild (http://www.physics.odu.edu/~hyde/Teaching/Phys332_Wk13.ppt)

[19] Potter LA. The Art of Cello Playing. Alfred Music Publishing, 1996 ISBN 0874870712, pp. 11-12

[20] Alan Stevenson. "Table of 'cello measurements" (http://web.archive.org/web/20080104141444/http://www.stevensoncases.co.uk/chart.htm). Archived from the original (http://www.stevensoncases.co.uk/chart.htm) on 04/01/2008. . Retrieved 10/26 2007.

[21] Beare, Charles; Carlson, Bruce (1993). "Foreword by Yo-Yo Ma" (http://web.archive.org/web/20060101030514/http://www.beares.com/Noteyoyoma.htm). *Antonio Stradivari: The Cremona Exhibition of 1987*. London: J. & A. Beare. ISBN 095193970X. . Retrieved 2008-09-26.

[22] National Music Museum page

References

- Stephen Bonta. "Violoncello", *Grove Music Online*, ed. L. Macy (accessed January 28, 2006), grovemusic.com (http://www.grovemusic.com/) (subscription access).
- Cyr, Mary. "Basses and basse continue in the Orchestra of the Paris Opéra 1700-1764". *Early Music* **XVIII** (Apr., 1982): 155–170.
- Grassineau, James (1740). *A Musical Dictionary*. London: J. Wilcox. "VIOLONCELLO of the *Italians*, is properly what we call the Bass Violin with four strings, sometimes even five or six; but those are not common, the first being most used among us."
- Holman, Peter (1982). "The English Royal Violin Consort in the Sixteenth Century". *Proceedings of the Royal Musical Association* **109**: 39–59. doi:10.1093/jrma/109.1.39.
- Jesselson, Robert. "The Etymology of Violoncello: Implications on Literature in the Early History of the Cello" (http://www.cello.org/Newsletter/Articles/celloetymology.htm). *Strings Magazine* **No. 22** (JAN/FEB 1991).
- "The King Violoncello by Andrea Amati, Cremona, after 1538" (http://www.usd.edu/smm/Cellos/Amati/Amaticello.html). National Music Museum. Retrieved 2008-11-02.
- Woodfield, Ian (1984) [1984]. Howard Mayer Brown, Peter le Huray, John Stevens. ed. *The Early History of the Viol*. Cambridge: Cambridge University Press. ISBN 0 521 24292 4.
- Marcella Ghigi, **"Il violoncello. Conoscere la tecnica per esprimere la musica"**, Milano, Casa Musicale Sonzogno (http://www.sonzogno.it), 1999. ISBN 88-87318-08-5 with a preface by Mario Brunello.

Further reading

- Machover, Tod, "My Cello" (http://web.media.mit.edu/~tod/media/pdfs/MachoverMyCello.pdf) in Turkle, Sherry (editor), *Evocative objects : things we think with*, Cambridge, Mass. : MIT Press, 2007. ISBN 978-0-262-20168-1

External links

- CelloBello - Online Cello Resource Center (Educational) (http://www.cellobello.com/)
- The Internet Cello Society (http://www.cello.org/)
- Sources for the prescribed sheet music for the ABRSM practical Cello exams (http://royalschoolsources.com/Strings/cello.html)
- cellist.nl (http://cellist.nl/): An international register of professional cellists, teachers, and students.
- Cello History (http://www.chrisbsmusic.com/cellohistory.html): A brief history of the cello

Tubular bell

Tubular bells

Other names	Chimes
Classification	Percussion instrument
Playing range	
C4-F5	

Tubular bells (also known as **chimes**) are musical instruments in the percussion family. Each bell is a metal tube, 30–38 mm (1¼–1½ inches) in diameter, tuned by altering its length. Tubular bells are often replaced by studio chimes, which are a smaller and usually less expensive instrument. Studio chimes are similar in appearance to tubular bells, but each bell has a smaller diameter than the corresponding bell on tubular bells.

Tubular bells are typically struck on the top edge of the tube with a rawhide- or plastic-headed hammer. Often, a sustain pedal will be attached to allow extended ringing of the bells. They can also be bowed at the bottom of the tube to produce a very loud, very high-pitched overtone.

Tubular bells have been popularized in western culture by the song "Carol of the Bells", and the Mike Oldfield album *Tubular Bells* and its sequels, the latter best known as the opening theme from *The Exorcist*.

The tubes used provide a purer tone than solid cylindrical chimes, such as those on a mark tree.

The animated television series *Futurama*'s theme is played on tubular bells. The "funding for this program provided by ..." rider that followed the end credits of the children's television show *Sesame Street* also prominently featured tubular bells in the 1980s.

Chimes are often used in concert band pieces (e.g. "Eiger" by James Swearingen). Most composers write Chimes under the category of Percussion > Mallet Percussion. It rarely plays melody, mostly a bass that brings out some color but sometimes has some solos or solis, often very simple.

As church bells

An example of tubular bells used as church bells is St' Alban's Anglican Church in Copenhagen.[1]

References

[1] "About the Church" (http://www.st-albans.dk/about-us/about-the-church/). St. Alben's Church. . Retrieved 2010-02-26.

External links

- Information about tubular bells (http://www.vsl.co.at/en-us/70/3196/3216/3217/5821.vsl) – Vienna Symphonic Library

Sarangi

Sarangi

Classification	• Chordophone
Related instruments	
• Esraj (India) • Sarinda (India)	

The **Sārangī** (Hindi: सारंगी, Punjabi: ਸਰੰਗੀ, *sarangī*) is a bowed, short-necked string instrument of India. It plays an important role in India's Hindustani classical music tradition. Of all Indian instruments, it is said to most resemble the sound of the human voice – able to imitate vocal ornaments such as *gamakas* (shakes) and *meend* (sliding movements). It is also said to be the hardest Indian instrument to master.

History

Surjeet Singh tuning his Sarangi

The word *sarangi* is derived from two Hindi words: *sau* (meaning "hundred") and *rang* (meaning "colour"). This is because the sound of the *sarangi* is said to be as expressive and evocative as a hundred colours. Its origins are unknown, however most people believe that it became a mainstream instrument in the mid 18th Century. Notoriously difficult to play and tune, the *sarangi* has traditionally been used primarily for accompanying singers (shadowing the vocalist's improvisations),in recent times it has become recognised as a solo instrument by the efforts of Ram Narayan and Sabri Khan. Other current celebrated performers include Sultan Khan, Kamal Sabri, Dhruba Ghosh and Aruna Narayan Kalle, while eminent maestros of the past have included Bundu Khan, Nathu Khan, Sagiruddin Khan, Gopal Mishra and Shakoor Khan.

The repertoire of sarangi players is traditionally very closely related to vocal music. Nevertheless, a concert with a solo *sarangi* as the main item will probably include a full-scale raga presentation with an extensive alap (the unmeasured improvisatory development of the raga) in increasing intensity (alap-jor-jhala) and several compositions in increasing tempi. As such, it is on a par with other instrumental styles such as for sitar, sarod, and bansuri. This full-fledged raga development has its roots in the Dhrupad style of raga presentation.

Sarangi music is often vocal music. It is rare to find a *sarangi* player who does not know the words of many classical compositions. The words are usually mentally present during performance, and performance almost always adheres

to the conventions of vocal performance including the organisational structure, the types of elaboration, the tempo, the relationship between sound and silence, and the presentation of *khyal* and *thumri* compositions. The vocal quality of sarangi is in a quite separate category from, for instance, the so-called *gayaki-ang* of sitar which attempts to imitate the nuances of *khyal* while overall conforming to the structures and usually keeping to the *gat* compositions of instrumental music. (A *gat* is a composition set to a cyclic rhythm.)

The *sarangi* is also a traditional stringed musical instrument of Nepal, commonly played by the Gaine or Gandarbha ethnic group.

Structure

A lying sarangi

Carved from a single block of wood, the *sarangi* has a box-like shape, usually around two feet long and around half a foot wide. The lower resonance chamber is made from a hollowed-out block of *tun* (red cedar) wood and covered with parchment and a decorated strip of leather at the waist which supports the elephant-shaped bridge. The bridge in turn supports the huge pressure of approximately 40 strings. Three of the strings – the comparatively thick, tight and short ones – are bowed with a heavy horsehair bow and "stopped" not with the finger-tips but with the nails, cuticles and surrounding flesh (talcum powder is applied to the fingers as a lubricant). The remaining strings are resonance strings or *tarabs* (see: sympathetic strings), numbering up to around 35, divided into 4 different "choirs". On the lowest level are a diatonic row of 9 tarabs and a chromatic row of 15 *tarabs*, each encompassing a full octave plus 1–3 extra notes above or below. Between these lower *tarabs* and the main playing strings lie two more sets of longer *tarabs*, which pass over a small flat ivory bridge at the top of the instrument. These are tuned to the important tones (*swaras*) of the raga. A properly tuned *sarangi* will hum and buzz like a bee-hive, with tones played on any of the main strings eliciting echo-like resonances. A few sarangis use strings manufactured from the intestines of goats - these harken back to the days when rich musicians could afford such strings.

Sarangi players

Music of Nepal: Topics	
Ethnic music	Newa music - Gurung music - Tamang music - Khas music - Mithila music - Sunuwar music - Magar music - Bhojpuri music - Sherpa music - Thakali music - Chepang music - Rai music - Tibetan music - Lepcha music - Limbu music - Kusunda music
Genres	Dapa - Dohari - Selo - Bhajan - Rodhi - Adhunik Sangeet - Rock - Hip hop
Festivals	Goon lā
Instruments	Dhimay - Bhusyah - Madal - Sarangi - Damfoo - Dholak - Chyambrung - Bansuri
Media	Radio Nepal, Hits FM [1], Image FM [2]
National anthem	"Sayaun Thunga Phool Ka"

In India and Pakistan

- Shaminderpal Singh
- Chamkaur Singh Jalalabadi
- Abdul Latif Khan
- Ahmed Khan (musician)
- Aruna Narayan Kalle
- Datararra Kazino
- Dattaramji Parwatkar
- Deepak Paramashivan (Bangalore)
- Dhruba Ghosh
- Farukh Latif Khan
- Faiyaz Khan (Bangalore)
- Ghulam Sabir Khan (Ambalewale)
- Ghulam Farid
- Gopal Mishra
- Harsh Narayan
- Kamal Sabri
- Khalifa Hafizullah Khan
- Mouddin Khan
- M.A. Banne
- Ram Narayan
- Vasanti Shrikhande

Rafiq Ahmed Khan

- Ramesh Mishra
- Sabri Khan
- Sarwar Hussain
- Shakur Khan
- Sultan Khan
- Vinod Pawar
- Sabir khan
- Abubakar Javed
- Dilshad khan
- Dr Taimur Khan
- Bundoo Khan
- Nathoo Khan
- Umrao Khan
- Ghulam Mohammad
- Nazim Ali Khan
- Hamid Hussain Khan
- Khawar Hussain
- Sharfuddin Khan
- Piroo Khan
- Mubarik Ali Khan
- Nabi Bakhsh
- Zohaib Hassan Khan
- Zahoori Khan
- Allah Rakha Khan

In Nepal

- Parashuram Bhandari
- Jhalak Man Gandarbha
- Khim Bahadur Gandarba
- Tirtha Bahadur Gandarbha
- Hari Sharan Nepali
- Shyam Nepal
- Hiralal Gandarbha
- Rubin Gandarbha
- Diwas Magar
- Honimaya Gandharba (from Prabash, Palpa)

A bamboo sarangi from Nepal

In UK

- Surjeet Singh
- Surinder Sandhu(Disciple of Ustad Sabri Khan)
- Harjider Singh Matharu (Disciple Of Ustad Sabri Khan and Kamal Sabri)

Sarangi Makers

- Masita (meerut)

- Behra (meerut)
- Rajesh Dhawan (meerut)
- Raj Musicals (New Delhi)

Modern performers who have used *sarangi* in compositions

- Dance Of The Desert by Kamal Sabri (http://www.raaga.com/channels/worldmusic/moviedetail.asp?mid=WM00007)Album Music Today-2006
- Sarangi Funk by Kamal Sabri (http://www.raaga.com/channels/worldmusic/album/WM00043.html)Album Music Today-2009
- Massive Attack in the album 100th window Sarangi by Kamal Sabri
- One Giant Leap Sarangi by Kamal Sabri
- Aerosmith, sarangi parts performed by Ramesh Mishra (featured on the track "Taste of India" from the 1997 album Nine Lives)
- Surinder Sandhu, The Fictionist with The Royal Liverpool Philharmonic Orchestra, SauRango Orchestra with Steve Vai and Cycles and Stories.
- Cheb i Sabbah
- Digital Bled
- Howard Shore (the Lothlórien portions of the score for *The Fellowship of the Ring*)
- Musafir, or Gypsies of Rajasthan
- Nitin Sawhney
- Robert Miles (on his 2001 album Organik)
- Secret Chiefs 3
- Steve Shelley of Sonic Youth
- Tabla Beat Science

- Tool (featured on the track "Reflection")
- Talvin Singh
- Robin Williamson of the Incredible String Band (notably in the song White Bird on the Changing Horses album)
- Blind Melon's track *Sleepyhouse* from their debut album *Blind Melon* contains a

References

[1] http://www.hitsfm.com.np
[2] http://www.imagechannels.com/imagefm.php?mainid=52

(http://www.chandrakantha.com/articles/indian_music/sarangi.html)

External links

- Sarangi Video (http://www.adguru.org/classical-music-f32-indian-sarangi-solo-music-video-t6137.html) by Nasir Khan
- Resham Firiri (http://www.ibiblio.org/musicnepal/2.mp3) A popular Nepali folk music with a Sarangi and *madal*.
- Nicolas Magriel's Sarangi Site (http://sarangi.net) most informative, a veritable treasure of information and archives
- sarangi.info (http://sarangi.info) - downloadable sarangi and vocal music, including the integral of two important books, The Voice of the Sarangi, Joep Bor; The Sarangi, by Ram Narayan and Neil Sorrell
- The Sarangi (http://www.chembur.com/instruments/sarangi/sarangi.htm) - This article on sarangis includes pictures of an exquisitely crafted *sarangi* by Paul Martin.
- Sadarang Archives (http://www.sadarang.com/Gallery Sarangi.htm) Gallery of Pakistani sarangi players
- Nepali Sarangi Video from YouTube (http://www.youtube.com/watch?v=7EcVBmaIkic)

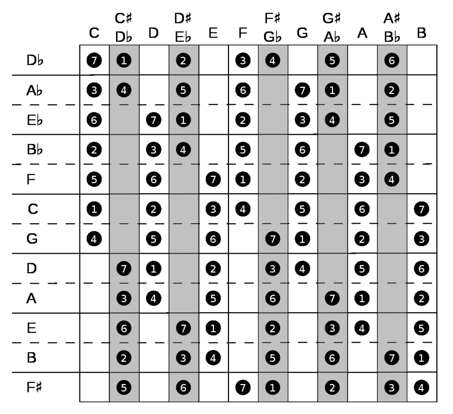
Three historic sarangi from The Metropolitan Museum of Art

- Sarangi, Gujarat, 19th century (http://www.metmuseum.org/toah/hd/indi/ho_89.4.200.htm)
- Sarangi, ca. 1900 (http://www.metmuseum.org/toah/hd/indi/ho_1982.143.2.htm)
- Sarangi, North India, late 19th century (http://www.metmuseum.org/toah/hd/indi/ho_46.34.43.htm)
- Autobiography of sarangi posted by paromita (http://sites.google.com/site/sapagroup1/literature/autobiography/sarangi)

TamTam Scales

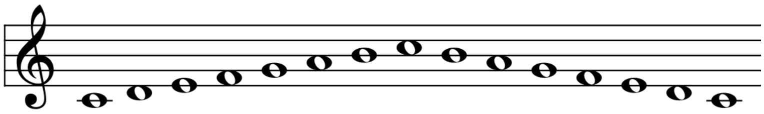
Major scale

In music theory, the **major scale** or Ionian scale is one of the diatonic scales. It is made up of seven distinct notes, plus an eighth which duplicates the first an octave higher. In solfege these notes correspond to the syllables "Do, Re, Mi, Fa, Sol, La, Ti/Si, (Do)", the "Do" in the parenthesis at the end being the octave of the tonic starting pitch. The simplest major scale to write or play on the piano is C major, the only major scale not to require sharps or flats, using only the white keys on the piano keyboard:



Major scales

C major scale



In rock and popular music examples of songs in Ionian include REO Speedwagon's "Take It on the Run", The Shirelles' "Will You Love Me Tomorrow", Gordon Lightfoot's "Carefree Highway", and Gin Blossoms' "Follow You Down".[1]

Structure

A major scale may be seen as two identical tetrachords separated by a whole tone, or whole step, the new set of steps "Whole:Whole:Half:Whole:Whole:Whole:Half"(in Semi-tone 2 2 1 2 2 2 1). Each tetrachord consists of two whole steps followed by a half step. Western scales do not skip any line or space on the staff, and they do not repeat any note with a different accidental. This has the effect of forcing the key signature to feature just sharps *or* just flats.

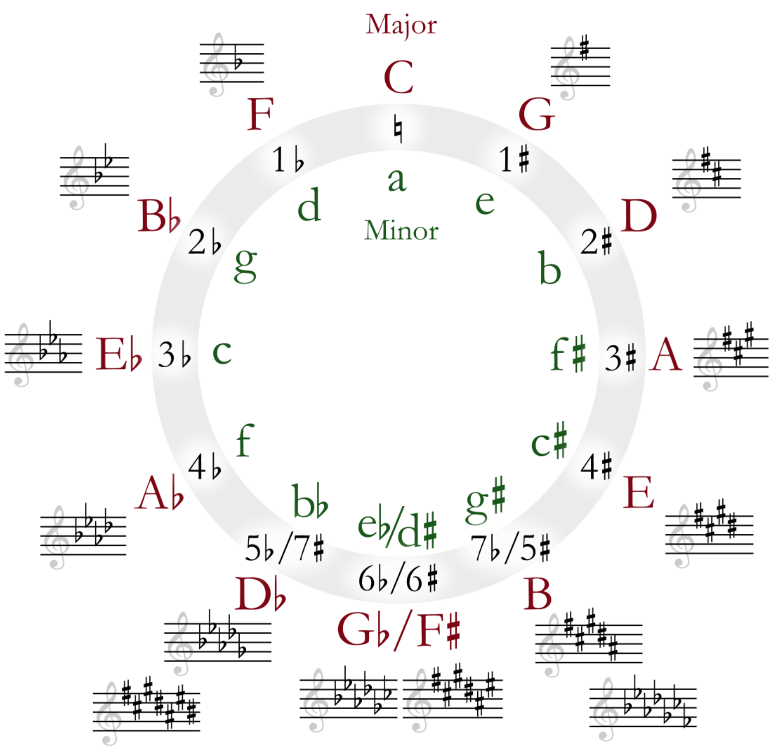
Pattern of whole and half steps

Named scale degrees

- 1st – Tonic- key note
- 2nd – Supertonic
- 3rd – Mediant
- 4th – Subdominant
- 5th – Dominant
- 6th – Submediant
- 7th – Leading tone
- 8th – Tonic (or Octave)

The circle of fifths

The Circle of Fifths, first described in 1728 by Johann David Heinichen in his book *Der General-bass*, has been used ever since as a means of illustrating the relative harmonic distance between musical keys. [2]

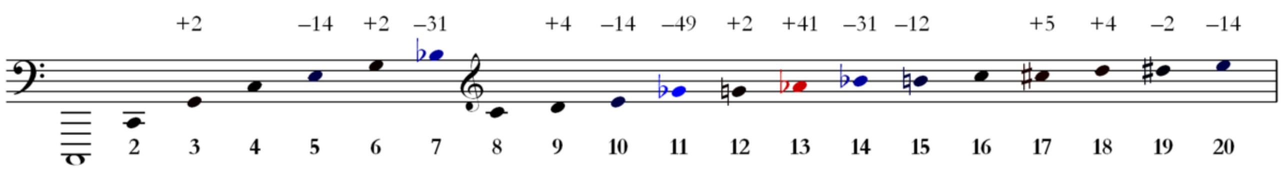


The numbers inside the circle show the number of sharps or flats in the key signature, with the sharp keys going clockwise, and the flat keys counterclockwise from C major (which has no sharps or flats.) The circular arrangement depends on enharmonic relationships in the circle, usually reckoned at six sharps or flats for the major keys of F♯ = G♭ and D♯ = E♭ for minor keys.[2] Seven sharps or flats make major keys (C♯ major and C♭ major) that may be more conveniently spelled with five flats or sharps (as D♭ major or B major).

Harmonic properties

The major scale may predominate the minor scale in Western music because of its unique harmonic properties ; in particular the major third is much stronger in the harmonic series (it is the 5th, 10th and 20th harmonic – see below) than the minor third (the 19th harmonic).

In other words, the first six notes of the harmonic series provide a consonant major chord, the fourth to sixth of which form a major triad, and seven of the nine notes between the 8th and 16th harmonics (the 7th and 15th overtones) are notes in the major scale in just intonation. See the following:

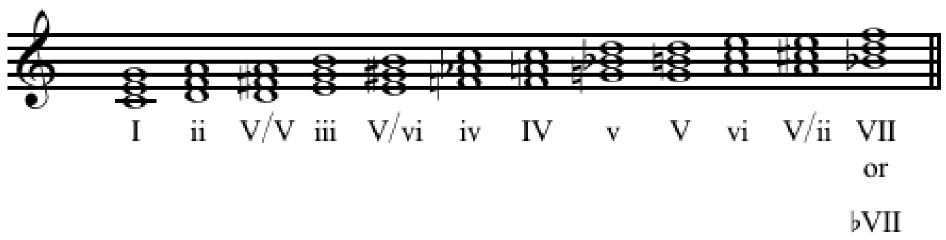


An illustration of the harmonic series as musical notation. The numbers above the harmonic indicate the number of cents it deviates from equal temperament. Red notes are sharp. Blue notes are flat.

The major scale allows:

- major or minor triads, both stable and consonant, on every scale degree but the seventh
- motion by a minor second from the leading tone up to the tonic (see resolution (music)) and from the subdominant down to the mediant.
- a dominant seventh chord on the fifth degree, the dominant (see voice leading)
- a diminished triad and a half-diminished seventh chord on the seventh degree, the leading tone.
- root motion by perfect fifths, the strongest root motion, from nearly every degree in either direction. The one exception is the unstable tritone interval between the fourth and seventh scale degrees, which is either a diminished fifth or its enharmonic equivalent, an augmented fourth.

Major system in Rock and Popular Music



Major system in C.

In rock and popular music, the major system is, "a chromatic system involving variable qualities (major and minor) of several chords whose roots are built on the notes of the Mixolydian scale."[3]

Though, "traditional functions do not apply," such as the, "brief forays into another key," implied by secondary dominants, the, "traditional," 'five-of' (V/x) names are often used by musicians without formal training and are useful to, "distinguish them from the...chords of the chromatic-minor system."[4] For example, in C minor one finds E♭ major (III, rather than V/VI) while in C major one finds E major (V/vi, rather than III), both of which are chromatic chords.

"As in the natural-minor system, no combination of major or minor triads could be arranged on all seven notes of the scale while preserving the diatonic integrity of the aggregate pitch content; the only solution that would produce a purely diatonic pitch content would involve a diminished chord, a type usually avoided in rock."[3]

Most songs, though, use only the diatonic chords: I, ii, iii, IV, V, vi, occasionally ♭VII, "even though the lowered seventh scale degree clashes chromatically with the raised form found as the third of the V chord," (though it, "arises much more frequently than it does in minor (there, generally a Neapolitan),") and, "infrequently, the minor v appears in an otherwise diatonic harmonic setting."[3]

Examples of use of the system, or a portion, include

- using only diatonic chords: The Young Rascals' "Lonely Too Long", Aerosmith's "Angel", The Byrds' "Turn! Turn! Turn! (To Everything There Is A Season)", and Stephanie Mills' "Never Knew Love Like This Before".[3]
- plus VII: A-Ha's "Take On Me", Gordon Lightfoot's "If You Could Read My Mind", Amy Grant's "Good For Me", Aretha Franklin's "(You Make Me Feel Like) A Natural Woman" (also Carole King), Elvis Costello and the Attractions' "Everyday I Write The Book", and the Traveling Wilburys' "Not Alone Any More".[3]
- I, IV, and v ("small number of songs"): The Kingsmen's "Louie Louie", K. C. and the Sunshine Band's "Get Down Tonight", and the verse of Huey Lewis and the News' "I Know What I Like".[3]
- full system: David Bowie's "Space Oddity" and Oasis' "Don't Look Back in Anger".[4]

References

[1] Stephenson, Ken (2002). *What to Listen for in Rock: A Stylistic Analysis*, p.39. ISBN 9780300092394.
[2] Drabkin, William. 2001. "Circle of Fifths". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.
[3] Stephenson (2002), p.92.
[4] Stephenson (2002), p.94.

Further reading

- Bower, Michael. 2007. " All about Key Signatures (http://www.empire.k12.ca.us/capistrano/Mike/capmusic/Key Signatures/key_signatures.htm)". Modesto, CA: Capistrano School (K–12) website. (Accessed 17 March 2010)
- Jones, George Thaddeus. 1974. *Music Theory: The Fundamental Concepts of Tonal Music Including Notation, Terminology, and Harmony*. Barnes & Noble Outline Series 137. New York, Hagerstown, San Francisco, London: Barnes & Noble. ISBN 978-0-06-40137-4.
- Kennedy, Michael. 1994. "Key-Signature". *Oxford Dictionary of Music*, second edition, associate editor, Joyce Bourne. Oxford and New York: Oxford University Press. ISBN 0198691629.
- Yamaguchi, Masaya. 2006. *The Complete Thesaurus of Musical Scales*, revised edition. New York: Masaya Music Services. ISBN 0967635306.

External links

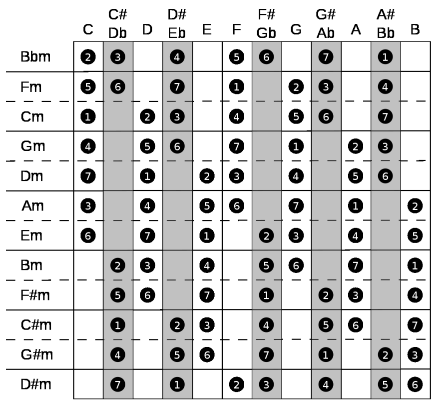
- Proper fingering of the major and minor scales on the piano (http://www.audiblefaith.com/artists/rharrell/music/pianoscales.html)
- Listen to and download harmonised Major scale piano MP3s (http://www.youraccompanist.com/index.php?option=com_content&task=view&id=62&Itemid=104)
- The major and pentatonic scales on the guitar (http://www.sque.co.uk/guitar/) in several positions
- The major scale for guitar (http://www.jazzguitar.be/music-theory.html) in one position, with derivation

Minor scale

Minor scale

Qualities	
Number of pitch classes	7
•	Maximal evenness

A **minor scale** in music theory is generally any scale that includes at least three essential scale degrees: one being the tonic, another at an interval of a minor third above the tonic, and another at an interval of a perfect fifth above the tonic, together composing the tonic minor triad. While this definition encompasses many scales and modes such as Dorian mode and the Phrygian mode, the term in its stricter sense is usually limited to the **natural minor**, **harmonic minor**, and **melodic minor** scales, described below, which are in most common use in Western classical music (*see* major and minor).



Natural minor Scales

Natural minor

The natural minor scale is the sixth mode (or Aeolian mode) of the major scale. For example, the white notes of a keyboard if played from any C continuing up an octave to the next C produce a C major scale. If the white notes are played beginning from the sixth step of that C scale, from any A to an A an octave above, then an A natural minor scale (the "relative minor" of C) is produced.

Natural Minor Scale: 1 2 ♭3 4 5 ♭6 ♭7 8

In rock and popular music examples of songs in Aeolian include The Moody Blues' "Nights in White Satin", Blondie's "Call Me", and Chicago's "25 Or 6 To 4".[1]

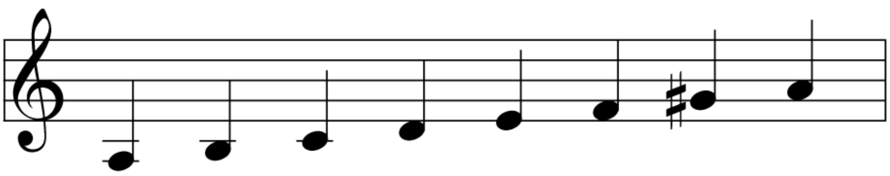
Harmonic and melodic minor

The **harmonic minor** scale is the same as the natural minor but with a chromatically raised seventh degree.

Harmonic Minor Scale: 1 2 ♭3 4 5 ♭6 7 8

For example, in the key of A minor, the harmonic minor scale is:

A B C D E F G♯ A'



Play

An important characteristic of the harmonic minor scale—in contrast to the natural minor—is its inclusion of two sets of chords whose inversions are structurally identical, and hence have ambiguous tonality. These are the Diminished seventh chord (found on the 2nd, 4th, 6th and 7th degrees) and the Augmented chord (found on the 3rd, 5th and 7th degrees).

The harmonic minor is also occasionally referred to as the **Mohammedan scale**[2] as its upper tetrachord corresponds to the Hijaz jins, commonly found in Middle Eastern music. The harmonic minor scale as a whole is

described as *Nahawand-Hijaz*[3] in Arabic nomenclature, or as *Bûselik Hicaz* [4] in Turkish nomenclature.

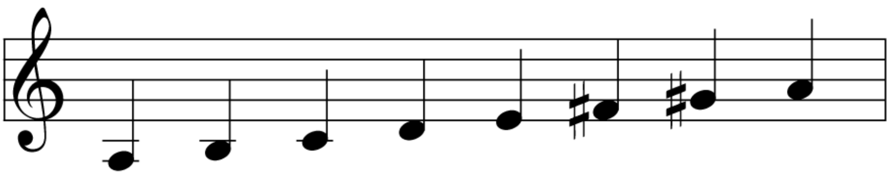
The interval between the sixth and seventh degrees of this scale (in this case F and G♯) is an augmented second. While some composers, notably Mozart, have used this interval to advantage in melodic composition, other composers, having felt it to be an awkward leap, particularly in vocal music, considered a whole step between these two scale degrees more conducive to smooth melody writing, so either the sixth scale degree was raised or the seventh flattened. Traditionally, music theorists have called these two options the **ascending melodic minor scale** (also known as **heptatonia seconda**) and **descending melodic minor scale**, the ascending being identical in its upper tetrachord to the major scale, and the descending being simply the natural minor:

Ascending Melodic Minor Scale: 1 2 ♭3 4 5 6 7 8

A B C D E F♯ G♯ A'

and then the Descending Melodic Minor Scale (the Natural Minor: see above):

A' G F E D C B A



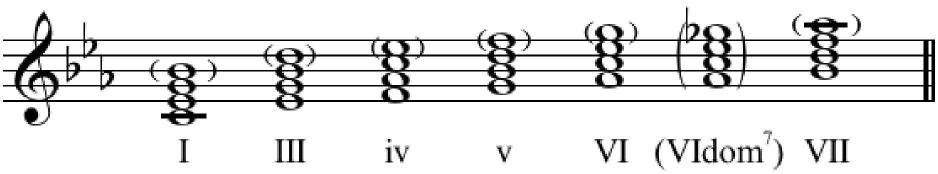
Play

Play

Composers have not been consistent in using these in ascending and descending melodies. Just as often, composers choose one form or the other based on whether one of the two notes is part of the most recent chord (the *prevailing harmony*). Particularly, to use the triad of the relative major—which is very common—since this is based on the third degree of the minor scale, the raised seventh degree would cause an augmented triad. Composers thus frequently require the lowered seventh degree found in the natural minor. In jazz, the descending aeolian is usually disregarded altogether.

Examples of the use of melodic minor in rock and popular music include Elton John's "Sorry Seems To Be The Hardest Word", which makes, "a nod to the common practice...by the use of F♯ [the leading-tone in G minor] as the penultimate note of the final cadence."[5]

Natural-minor system

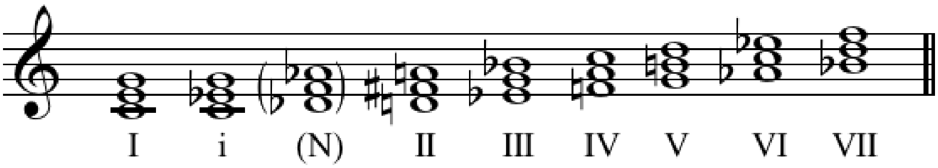


Natural-minor system in C.[6]

The natural-minor system is defined by, "(1) the use of only major and minor triads (or seventh chords made out of them) and (2) keeping the natural-minor scale pure as the aggregate pitch content," with the one exception being the chromaticism of the VIdom7.[6] Thus minor triads on $\hat{1}$, $\hat{4}$, and $\hat{5}$, and major on $\hat{3}$, $\hat{6}$, $\hat{7}$, are allowed but no form on the second is, either the altered major [in C: D♭-F-A♭] or minor [D-F-A♮], or the already occurring but consistently avoided diminished triad [D-F-A♭].[6]

"The natural-minor system, though the simplest of the harmonic systems used in rock [and popular music], is also the least common."[6] However, examples of pieces in natural minor include Billy Ocean' "Caribbean Queen", R.E.M.'s "Losing My Religion", Styx's "Blue Collar Man (Long Nights)", K.C. and the Sunshine Band's "That's the Way (I Like It)", the Romantics' "Talking In Your Sleep", the Animals' "Please Don't Let Me Be Misunderstood", Fleetwood Mac's "I'm So Afraid", Bill Withers' "Ain't No Sunshine", and, with IVdom7, Eric Clapton's "I Shot The Sheriff".[6]

Chromatic-minor system



Chromatic-minor system in C.[7]

The **chromatic-minor system** is a natural minor scale with major triads built on every step, though the first may be major or minor (the tonic to Eric Clapton's "After Midnight" is major on *Eric Clapton* and minor on *Crossroads*[8]) and occasionally the second may be lowered (a Neapolitan chord). "Whereas the construction of the natural-minor system involves the consistent use of a scale at the expense of variety in triad qualities, the chromatic-minor system involves consistent use of a particular triad type—the major triad—at the expense of purity of scale." Thus variants of the third, fourth, sixth, and seventh are found. Seventh chords are usually dominant sevenths, involving further chromaticism. II and VI are generally not used together, "perhaps because the tritone between their roots leaves the chords too distant." Due to the unusual nature of this system, rather than V/V the major triad built on the second step is notated II.[7]

Examples of its use

- featuring major tonic include: The Rolling Stones' "Brown Sugar" (without II), The Beatles' "Sgt. Pepper's Lonely Hearts Club Band" (without VI), Eddie Floyd's "Knock On Wood", The Beatles' "Here Comes The Sun", The Who's "Pinball Wizard", The Bangles' "Walk Like An Egyptian", Bachman-Turner Overdrive's "Roll On Down The Highway", Eric Clapton's "Cocaine", Grand Funk's "We're An American Band", Devo's "Whip It", and Harry Chapin's "Cat's In The Cradle".[7]
- featuring minor tonic include: R.E.O Speedwagon's "Ridin' The Storm Out", The Rolling Stones' "Paint It, Black", The Clovers' "Love Potion No. 9", The Animals' "House Of The Rising Sun", Jefferson Airplane's "Somebody To Love", Tom Petty's "Refugee", The Who's "I Can See For Miles", and The Partridge Family's "I Woke Up In Love This Morning".[7]
- featuring variable tonic include: The Turtles' "Happy Together".[7]
- featuring open fifth as tonic include: Booker T. and the MGs' "Green Onions".[7]
- featuring N include: Joni Mitchell's "Help Me", The Mama and the Papas' "Monday, Monday", Kansas's "Carry On Wayward Son", and The Moody Blues' "Nights In White Satin".[7]
- featuring VI(dom7) include: Linda Ronstadt's "You're No Good", and Aerosmith's "Toys In The Attic".[7]
- featuring VI and II without V: The Go-Gos' "We Got The Beat".[7]

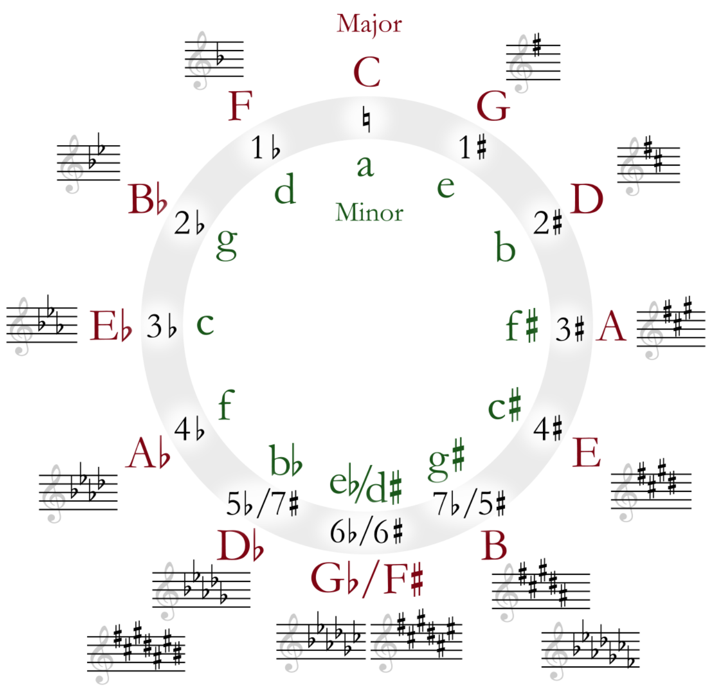
It may be seen that it is not an anomaly and that it may be used for, "a wide variety of expressive purposes."[7]

See also: Major system.

Finding key signatures

Major and minor keys that share the same signature are called *relative*; so C major is the relative major of A minor, and C minor is the relative minor of E♭ major. The relative major is a minor third above the tonic of the minor. For example, since the key signature of G major has one sharp (see major scales for how to find this), its relative minor, E minor, also has one sharp in its key signature.

Music may be written in an enharmonic scale (e.g. C♯ minor, which only has four sharps in its key signature, compared to the theoretical eight flats required for D♭ minor). The following are enharmonic equivalents:



Circle of fifths showing major and minor keys and their signatures

Key Sig.	Major Scale	Minor Scale
5♯/7♭	B/C♭ major	g♯/a♭ minor
6♯/6♭	F♯/G♭ major	d♯/e♭ minor
7♯/5♭	C♯/D♭ major	a♯/b♭ minor

Double sharps/double flats can be written as accidentals, but not as part of a key signature. For example:

D♭ Minor Key Signature: E♭ + A♭ + D♭ + G♭ + C♭ + F♭ + **B** 𝄫 (the B is now double flatted and therefore, notated **after** the single accidentals, which obviously do not include the B♭)

D♭ Natural Minor = D♭ E♭ F♭ G♭ A♭ **B** 𝄫 C♭ D♭

D♭ Melodic Minor (Ascending + Descending) = D♭ E♭ F♭ G♭ A♭ B♭ C D♭ C♭ **B** 𝄫 A♭ G♭ F♭ E♭ D♭

D♭ Harmonic Minor = D♭ E♭ F♭ G♭ A♭ **B** 𝄫 C D♭

References

[1] Stephenson, Ken (2002). *What to Listen for in Rock: A Stylistic Analysis*, p.39. ISBN 9780300092394.
[2] United States Patent: 5386757 (http://patft.uspto.gov/netacgi/nph-Parser?Sect2=PTO1&Sect2=HITOFF&p=1&u=/netahtml/PTO/search-bool.html&r=1&f=G&l=50&d=PALL&RefSrch=yes&Query=PN/5386757)
[3] "Maqam Nihawand" (http://www.oud.eclipse.co.uk/nihawand.html), *Oud.Eclipse.co.uk*.
[4] "Buselik Makam" (http://www.oud.eclipse.co.uk/buselik.html), *Oud.Eclipse.co.uk*.
[5] Stephenson (2002), p.41.
[6] Stephenson (2002), p.89.
[7] Stephenson (2002), p.90.
[8] Stephenson (2002), p.90-92.

External links

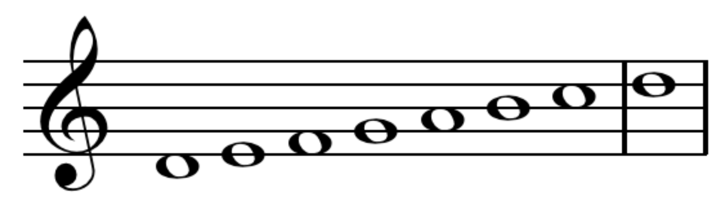
- 3 note per string Harmonic Minor scale shapes for guitar in PDF format for easy printing (http://robsilverguitars.blogspot.com/2010/01/harmonic-and-melodic-minor-scales.html)
- Proper fingering of the major and minor scales on the piano (http://www.audiblefaith.com/artists/rharrell/music/pianoscales.html)
- Listen to and download harmonised minor scale piano MP3s (http://www.youraccompanist.com/index.php?option=com_content&task=view&id=61&Itemid=104)
- Guitar: Harmonic minor scale explored (http://guitar.about.com/library/weekly/aa120500a.htm)
- The harmonic minor scale on the guitar (http://www.guitar-tutorial.net/harmonic.html)
- The natural minor scale on the guitar (http://www.fretjam.com/natural-minor-scale.html)
- The melodic minor scale on the guitar (http://www.fretjam.com/melodic-minor-scale.html)
- Discussing All Musical Scales and Theory (http://www.aminorscale.com)

Phrygian mode

Modern Phrygian mode on C Play.

The **Phrygian mode** (pronounced /ˈfrɪdʒiən/) can refer to three different musical modes: the ancient Greek *tonos* or *harmonia* sometimes called Phrygian, formed on a particular set octave species or scales; the Medieval Phrygian mode, and the modern conception of the Phrygian mode as a diatonic scale, based on the latter. It is also known in Arabic and in the Middle East as the Kurd mode.

Ancient Greek Phrygian mode



Diatonic genus of the Phrygian tonos on D Play.

The Phrygian *tonos* or *harmonia* is named after the ancient kingdom of Phrygia in Anatolia. The octave species (scale) underlying the ancient-Greek Phrygian *tonos* (in its diatonic genus) corresponds to the medieval and modern Dorian mode.

In Greek music theory, the *harmonia* given this name was based on a *tonos*, in turn based on a scale or octave species built from a tetrachord which, in its diatonic genus, consisted of a series of rising intervals of a whole tone, followed by a semitone, followed by a whole tone (in the chromatic genus, this was a minor third followed by two semitones, and in the enharmonic, a major third and two quarter tones). An octave species was then built upon two of these tetrachords separated by a whole tone. This is equivalent to playing all the white notes on a piano keyboard from D to D:

```
D E F G | A B C D
```

This scale, combined with a set of characteristic melodic behaviours and associated ethoi, constituted the *harmonia* which was given the ethnic name "Phrygian", after the "unbounded, ecstatic peoples of the wild, mountainous regions of the Anatolian highlands" (Solomon 1984, 249). This ethnic name was also confusingly applied by theorists such as Cleonides to one of thirteen chromatic transposition levels, regardless of the intervallic makup of the scale (Solomon 1984, 244–46).

Medieval Phrygian mode

The early Catholic church developed a system of eight musical modes that medieval music scholars gave names drawn from the ones used to describe the ancient Greek *harmoniai*. The name "Phrygian" was applied to the third of these eight church modes, the authentic mode on E, described as the diatonic octave extending from E to the E an octave higher and divided at B, therefore beginning with a semitone-tone-tone-tone pentachord, followed by a semitone-tone-tone tetrachord (Powers 2001): E F G A B + B C D E

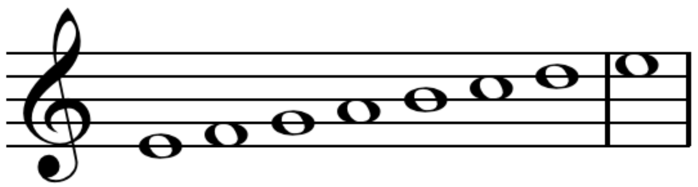
The ambitus of this mode extended one tone lower, to D. The sixth degree, C, which is the tenor of the corresponding third psalm tone, was regarded by most theorists as the most important note after the final, though the fifteenth-century theorist Johannes Tinctoris implied that the fourth degree, A, could be so regarded instead (Powers 2001).

Placing the two tetrachords together, and the single tone at bottom of the scale produces the Hypophrygian mode (below Phrygian):

```
G | A B C D | (D) E F G
```

Modern Phrygian mode

In modern music (from the 18th century onward), the Phrygian mode is related to the modern natural minor musical mode, also known as the Aeolian mode: the Phrygian scale differs in its second scale degree, which is a semitone lower than that of the Aeolian.



Modern Phrygian modal scale on E Play.

The following is the Phrygian mode starting on E, or E Phrygian, with corresponding tonal scale degrees illustrating how the modern major mode and natural minor mode can be altered to produce the Phrygian mode:

```
E Phrygian
Mode:  E  F   G   A  B  C   D   E
Major: 1  ♭2  ♭3  4  5  ♭6  ♭7  1
Minor: 1  ♭2  3   4  5  6   7   1
```

Modern uses of the Phrygian mode

Phrygian dominant

A Phrygian dominant scale is produced by raising the third scale degree of the mode:

```
E Phrygian dominant
Mode:  E  F G♯  A  B  C  D  E
Major: 1 ♭2  3  4  5 ♭6 ♭7 1
Minor: 1 ♭2 ♯3  4  5  6  7  1
```

The Phrygian dominant is also known as the **Spanish gypsy scale**, because it resembles the scales found in flamenco music (see Flamenco mode). Flamenco music uses the Phrygian scale, together with a modified scale resembling the Arab *maqām Ḥijāzī* (like the Phrygian dominant but with a major sixth scale degree), and a bimodal configuration using both major and minor second and third scale degrees (Katz 2001).

The Phrygian Mode in Jazz

In contemporary jazz the Phrygian mode is used over chords and sonorities built on the mode, such as the **sus4(♭9)** chord (see Suspended chord), which is sometimes called a phrygian suspended chord. For example a soloist might play an E Phrygian over an Esus4(♭9) chord (E-A-B-D-F).

Examples of Jazz compositions using the Phrygian mode include "Ole" by John Coltrane, "Bemsha Swing," by Thelonious Monk and Denzil Best, "La Fiesta" by Chick Corea, "Masqualero" by Wayne Shorter, "Little One" by Herbie Hancock and "Solea" by Gil Evans (Pelletier-Bacquaert [n.d.]).

Examples

Medieval and Renaissance

- The Roman chant variant of the Requiem introit "Rogamus te" is in the (authentic) Phrygian mode, or 3rd tone (Karp, Fitch, and Smallman 2001, §1).
- The following compositions of Josquin are written in the Phrygian mode:
  - 4-part setting of Mille Regretz
  - *Missa Pange lingua*
  - 6-part motet Praeter Rerum Seriem
- Orlando di Lasso's motet *In me transierunt* (Pesic 2005, *passim*).
- Giovanni Pierluigi da Palestrina's motet *Congratulamini mihi* (Carver 2005, 77).
- Cipriano de Rore's 7-part Missa Praeter Rerum Seriem

Baroque

- Johann Sebastian Bach's keeps in his cantatas the Phrygian mode of some original chorale melodies, such as Luther's *Aus tiefer Not schrei ich zu dir* in *Aus tiefer Not schrei ich zu dir, BWV 38*, and *Es woll uns Gott genädig sein* on a melody by Matthaeus Greiter (c. 1490-1552), twice in *Die Himmel erzählen die Ehre Gottes, BWV 76* (Braatz 2006).
- Heinrich Schütz's *St John Passion* (1666) is in the Phrygian mode (Rifkin, Linfield, McCulloch, and Baron 2001, §10)
- Dieterich Buxtehude's Prelude in A minor, BuxWV 152 (Snyder 2001), (labeled *Phrygisch* in the BuxWV catalog) (Karstädt 1985,)

Romantic

- Anton Bruckner:
  - *Ave Regina coelorum* (1885–88) (Carver 2005, 76–77).
  - *Pange lingua* (second setting, 1868), WAB 33 (Carver 2005, 79; Partsch 2007, 227).
  - Symphony no. 3, passages in the third (scherzo) and fourth movements (Carver 2005, 89–90).
  - Symphony no. 4 (third version, 1880), Finale (Carver 2005, 90–92).
  - Symphony no. 6, first, third (scherzo), and fourth movements (Carver 2005, 91–98).
  - Symphony no. 7, first movement (Carver 2005, 96–97).
  - Symphony no. 8, first and fourth movements (Carver 2005, 98).
  - *Tota pulchra es Maria* (1878) (Carver 2005, 79, 81–88).
  - *Vexilla regis* (1892) (Carver 2005, 79–80).
- Ralph Vaughan Williams' *Fantasia on a Theme of Thomas Tallis* (Ottaway and Frogley 2001), based on Thomas Tallis's 1567 setting of Psalm 2, "Why fum'th in fight".

Modern

- John Coolidge Adams, *Phrygian Gates* (J. Adams 2010)
- Samuel Barber:
  - *Adagio for Strings*, op. 11 (Pollock 2000, 191)
  - "I Hear an Army", from *Three Songs*, op. 10 (Pollock 2000, 191)
- Philip Glass, the final aria from *Satyagraha* (Strickland 2001).
- Howard Shore, "Prologue" accompanying the opening sequence of LOTR: The Fellowship of the Ring film (D. Adams 2010,).

References

- Adams, Doug. 2010. *The Music of the Lord of the Rings Films: A Comprehensive Account of Howard Shore's Scores*. Van Nuys, CA: Carpentier/Alfred Music Publishing. ISBN 0739071572.
- Adams, John. 2010. "John Adams | [[Phrygian Gates [1]]]." John Adams: Official Web Site. Web. 08 June 2011.
- Braatz, Thomas, and Aryeh Oron. 2006. "Chorale Melodies used in Bach's Vocal Works *Es woll (or wolle/wollt) uns Gott genädig sein* [2]". (April) (accessed 24 October 2009)
- Carver, Anthony F. 2005. "Bruckner and the Phrygian Mode". *Music and Letters* 86, no. 1:74–99. doi:10.1093/ml/gci004
- Franklin, Don O. 1996. "Vom alten zum neuen Adam: Phrygischer Kirchenton und moderne Tonalität in J.S.Bachs Kantate 38". In *Von Luther zu Bach: Bericht über die Tagung 22.–25. September 1996 in Eisenach*, edited by Renate Steiger, 129–44. Internationalen Arbeitsgemeinschaft für theologische Bachforschung (1996): Eisenach. Sinzig: Studio-Verlag. ISBN 3-89564-056-5
- Gombosi, Otto. 1951. "Key, Mode, Species". *Journal of the American Musicological Society* 4, no. 1:20–26. http://www.jstor.org/stable/830117 (Subscription access) doi:10.1525/jams.1951.4.1.03a00020
- Karp, Theodore, Fabrice Fitch, and Basil Smallman. 2001. "Requiem Mass". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.
- Karstädt, G. (ed.). 1985. *Thematisch-systematisches Verzeichnis der musikalischen Werke von Dietrich Buxtehude: Buxtehude-Werke-Verzeichnis*, second edition. Wiesbaden. French online adaptation, "Dietrich Buxtehude, (c1637 - 1707) Catalogue des oeuvres BuxWV: Oeuvres instrumentales: Musique pour orgue, BuxWV 136–225 [3]". Université du Québec website (Accessed 17 May 2011).
- Katz, Israel J. 2001. "Flamenco [cante flamenco]". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.

- Novack, Saul. 1977. "The Significance of the Phrygian Mode in the History of Tonality". *Miscellanea Musicologica* 9:82–177. ISSN 0076-9355 OCLC 1758333
- Ottaway, Hugh, and Alain Frogley. 2001. "Vaughan Williams, Ralph". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.
- Partsch, Erich Wolfgang. 2007. "Anton Bruckners phrygisches Pange lingua (WAB 33)". *Singende Kirche* 54, no. 4:227–29. ISSN 0037-5721
- Pelletier-Bacquaert, Bruno. [n.d.] "Various Thoughts: Sus Chords". http://brunojazz.com/vt-SusChords1.htm, accessed Dec. 10, 2009.
- Pesic, Peter. 2005. "Earthly Music and Cosmic Harmony: Johannes Kepler's Interest in Practical Music, Especially Orlando di Lasso". *Journal of Seventeenth-Century Music* 11, no. 1 http://www.sscm-jscm.org/v11/no1/pesic.html
- Pollack, Howard. 2000. "Samuel Barber, Jean Sibelius, and the Making of an American Romantic". *The Musical Quarterly* 84, no. 2 (Summer) 175–205.
- Powers, Harold S. 2001. "Phrygian", *The New Grove Dictionary of Music and Musicians*, edited by Stanley Sadie and John Tyrrell, 19:634. 29 vols. London: Macmillan Publishers. ISBN 978-1-56159-239-5 ISBN 978-0-19517-067-2 OCLC 46516598
- Rifkin, Joshua, Eva Linfield, Derek McCulloch, and Stephen Baron. 2001. "Schütz, Heinrich [Henrich] [Sagittarius, Henricus]". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.
- Solomon, Jon. 1984. "Towards a History of *Tonoi*". *Journal of Musicology* 3, no. 3:242–51. http://www.jstor.org/stable/763814 (Subscription access) doi:10.1525/jm.1984.3.3.03a00030
- Snyder, Kerala J. 2001. "Buxtehude, Dieterich". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.
- Strickland, Edward. 2001. "Glass, Philip". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell. London: Macmillan Publishers.

Further reading

- Tilton, Mary C. 1989. "The Influence of Psalm Tone and Mode on the Structure of the Phrygian Toccatas of Claudio Merulo". *Theoria* 4:106–22. ISSN 0040-5817

References

[1] http://www.earbox.com/W-phrygiangates.html
[2] http://www.bach-cantatas.com/CM/Es-woll-uns.htm
[3] http://infopuq.uquebec.ca/~uss1010/catal/buxtehude/buxdcati1.html

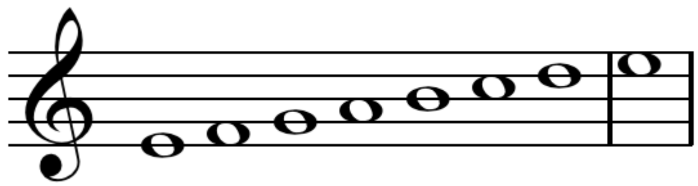
Dorian mode

Due to historical confusion, ***Dorian mode*** or ***Doric mode*** (also **Russian minor**[1]) can refer to two very different musical modes or diatonic scales, the Greek or the medieval and modern.

Modern Dorian scale on C Play.

Greek Dorian mode

The Dorian mode (properly *harmonia* or *tonos*) is named after the Dorian Greeks. Applied to a whole octave, the Dorian octave species was built upon two tetrachords separated by a whole tone, running from the *hypate meson* to the *nete diezeugmenon*. In the diatonic genus, the intervals in each tetrachord are semitone-tone-tone, and so the sequence over the octave is the same as that produced by playing all the white notes of a piano ascending from E to E: E F G A | B C D E,[2] a sequence equivalent to the modern Phrygian mode. Placing the single tone at the bottom of the scale followed by two conjunct tetrachords (that is, the top note of the first tetrachord is also the bottom note of the second), produces the Hypodorian ("below Dorian") octave species: A | B C D E | (E) F G A. Placing the two tetrachords together and the single tone at the top of the scale produces the Mixolydian octave species, a note sequence equivalent to modern Locrian mode.[3]



Greek Dorian mode (diatonic genus) on E Play.

Medieval and modern Dorian mode

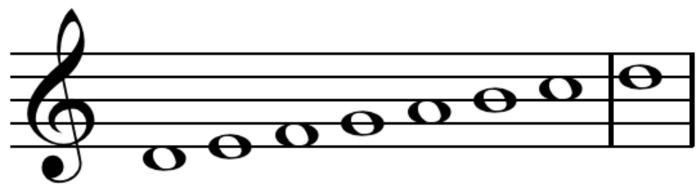
Medieval Dorian mode

The early Byzantine church developed a system of eight musical modes (the octoechoi), which served as a model for medieval European chant theorists when they developed their own modal classification system starting in the 9th century.[4] The success of the Western synthesis of this system with elements from the fourth book of *De institutione musica* of Boethius, created the false impression that the Byzantine oktōēchos were inherited directly from ancient Greece.[5] Originally used to designate one of the traditional *harmoniai* of Greek theory (a term with various meanings, including the sense of an octave consisting of eight tones), the name was appropriated (along with six others) by the 2nd-century theorist Ptolemy to designate his seven *tonoi*, or transposition keys. Four centuries later, Boethius interpreted Ptolemy in Latin, still with the meaning of transposition keys, not scales. When chant theory was first being formulated in the 9th century, these seven names plus an eighth, Hypermixolydian (later changed to Hypomixolydian), were again re-appropriated in the anonymous treatise *Alia Musica*. A commentary on that treatise, called the *Nova expositio*, first gave it a new sense as one of a set of eight diatonic species of the octave, or scales. In medieval theory, the authentic Dorian mode could include the note B♭ "by licence", in addition to B♮.[6] The same scalar pattern, but starting a fourth or fifth below the mode final D, and extending a fifth above (or a sixth, terminating on B♭), was numbered as mode 2 in the medieval system. This was the plagal mode corresponding to the authentic Dorian, and was called the Hypodorian mode.[7] In the untransposed form on D, in both the authentic and

plagal forms the note C is often raised to C♯ to form a leading tone, and the variable sixth step is in general B♮ in ascending lines and B♭ in descent.[8]

Modern Dorian mode

The modern Dorian mode, by contrast, is a strictly diatonic scale corresponding to the white keys of the piano from "D" to "D", thus the name **D Dorian**, or any transposition of its interval pattern, which has the ascending pattern of:



Modern Dorian scale on D Play.

> Whole Step - Half Step - Whole Step - Whole Step - Whole Step - Half Step - Whole Step

or more simply:

> w-h-w-w-w-h-w.

It can also be thought of as:

> Tone - Semitone - Tone - Tone - Tone - Semitone - Tone
>
> T-S-T-T-T-S-T.

or simply as a scale with a minor 3rd and 7th, a major 2nd and 6th, and a perfect 4th and 5th.

It may be considered an "excerpt" of a major scale played from the pitch a whole tone above the major scale's tonic (in the key of C Major it would be D, E, F, G, A, B, C, D), i.e., a major scale played from its second scale degree up to its second degree again. The resulting scale is, however, *minor* (or has a minor "feel" or character) because as the "D" becomes the new tonal centre the minor third between the D and the F make us "hear minor". If we build a chord on the tonic, third and fifth, it is a minor chord.

Examples of the Dorian mode include:

- The D Dorian mode contains all notes the same as the C major scale starting on D.
- The G Dorian mode contains all notes the same as the F major scale starting on G.
- The A♭ Dorian mode contains all notes the same as the G♭ major scale starting on A♭.

The Dorian mode is symmetric, meaning that the pattern of tones and semitones (T-s-T-T-T-s-T) is the same ascending or descending.

The modern Dorian mode is equivalent to the natural minor scale (or the Aeolian mode) but with the sixth degree raised a semi-tone. Confusingly, the modern Dorian mode is the same as the Greek Phrygian mode.

The only difference between the Dorian and Aeolian scales is whether or not the 6th is major (in the Aeolian it is minor, in the Dorian it is major). The I, IV, and V triads of the Dorian mode are minor, major, and minor, respectively (i-IV-v), instead of all minor (i-iv-v) as in Aeolian. In both the Dorian and Aeolian, strictly applied, the dominant triad is minor, in contrast to the modern minor key, where it is normally major (see harmonic minor). It is also worth noting that the sixth is often raised in minor music as it is in the dorian mode (see melodic minor).

Notable compositions in Dorian mode

- "Along Comes Mary" by The Association[9]
- "Drunken Sailor"[10]
- "Eleanor Rigby" by The Beatles[11]
- "Scarborough Fair"[10]
- "Milestones" by Miles Davis[12] — The composition takes the form aabba with the a sections in G Dorian and the b sections in A Aeolian.[13]
- "The Wreck of the *Edmund Fitzgerald*" by Gordon Lightfoot[14]
- "So What" by Miles Davis[12] Written in D dorian and E♭ dorian.[15]
- The "Et incarnatus est" in the Credo movement of Beethoven's *Missa Solemnis*.[16]
- "Maiden Voyage" by Herbie Hancock[12]
- "Billie Jean" by Michael Jackson[12]

References

[1] So-called by Balakirev. Richard Taruskin, "From Subject to Style: Stravinsky and the Painters", in *Confronting Stravinsky: Man, Musician, and Modernist*, edited by Jann Pasler, 16–38 (Berkeley, Los Angeles, and London: University of California Press, 1986): 33. ISBN 0-520-05403-2.

[2] Thomas J. Mathiesen, "Greece, §I: Ancient: 6. Music Theory: (iii) Aristoxenian Tradition: (d) Scales". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London: Macmillan Publishers, 2001).

[3] Thomas J. Mathiesen, "Greece, §I: Ancient: 6. Music Theory: (iii) Aristoxenian Tradition: (e) Tonoi and Harmoniai". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London: Macmillan Publishers, 2001).

[4] Harold S. Powers, "Mode, §II: Medieval modal theory, 2: Carolingian synthesis, 9th–10th centuries", *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London: Macmillan Publications; New York: Grove's Dictionaries of Music, 2001). ISBN 9781561592395

[5] Peter Jeffery, "Oktōēchos", *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London: Macmillan Publications; New York: Grove's Dictionaries of Music, 2001). ISBN 9781561592395

[6] Harold S. Powers, "Dorian", *The New Grove Dictionary of Music and Musicians*, second edition, 29 vols., edited by Stanley Sadie and John Tyrrell (London: Macmillan Publishers, 2001): 7:507. ISBN 9781561592395

[7] Harold S. Powers, "Hypodorian", *The New Grove Dictionary of Music and Musicians*, second edition, 29 vols., edited by Stanley Sadie and John Tyrrell (London: Macmillan Publications, 2001): 12:36–37. ISBN 9781561592395

[8] Felix Salzer and Carl Schachter, *Counterpoint in Composition: The Study of Voice Leading* (New York: Columbia University Press, 1989): 10. ISBN 023107039X.

[9] Bernstein, Leonard. "Bernstein's Studio - Young People's Concerts - What is a mode?" (http://www.leonardbernstein.com/studio/element2.asp?id=395). Amberson Holdings LLC. . Retrieved 2008-06-06.

[10] Tillekens, Ger (November 2002). "Marks of the Dorian family" (http://www.icce.rug.nl/~soundscapes/VOLUME05/Dorian_family.shtml). Soundscapes. . Retrieved 30 June 2009.

[11] Pollack, Alan W.. "Notes on "Eleanor Rigby"" (http://www.icce.rug.nl/~soundscapes/DATABASES/AWP/er.shtml). . Retrieved 2008-08-11.

[12] Herder, Ronald (1987). *1000 Keyboard Ideas*, p.75. ISBN 9780943748481.

[13] Kernfeld, Barry Dean (2002). *The New Grove dictionary of jazz*. New York City: Macmillan Publishers. p. 785. ISBN 1-56159-284-6. OCLC 46956628.

[14] "Traditional & Folk Music - Encyclopedic Dictionary" (http://www.traditionalmusic.co.uk/traditional-music/ency/m3.htm). . Retrieved 2008-09-05.

[15] Lawn, Richard; Jeffrey L. Hellmer (1996). *Jazz: theory and practice*. Los Angeles: Alfred Publishing. p. 190 (http://books.google.com/books?id=mjaITr2NdkEC&pg=PA190). ISBN 0-88284-722-8.

[16] Steinberg, Michael (1994). "Notes on the Quartets". In Robert Winter and Robert Martin. *The Beethoven Quartet Companion*. Berkeley, California: University of California Press. p. 270. ISBN 978-0-520-20420-1. OCLC 27034831.

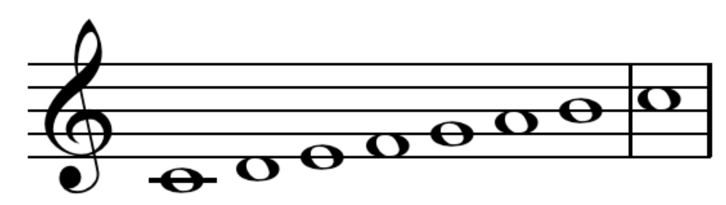
Lydian mode

Modern Lydian scale on C Play.

The **Lydian** musical scale is a rising pattern of pitches comprising three whole tones, a semitone, two more whole tones, and a final semitone. This sequence of pitches roughly describes the fifth of the eight Gregorian (church) modes, known as Mode V or the authentic mode on F, theoretically using B♮ but in practice more commonly featuring B♭ (Powers 2001)(see Lydian dominant scale). Because of the importance of the major scale in modern music, the Lydian mode is often described (or learned) as the scale that begins on the fourth scale degree of the major scale.

The Lydian mode in music theory

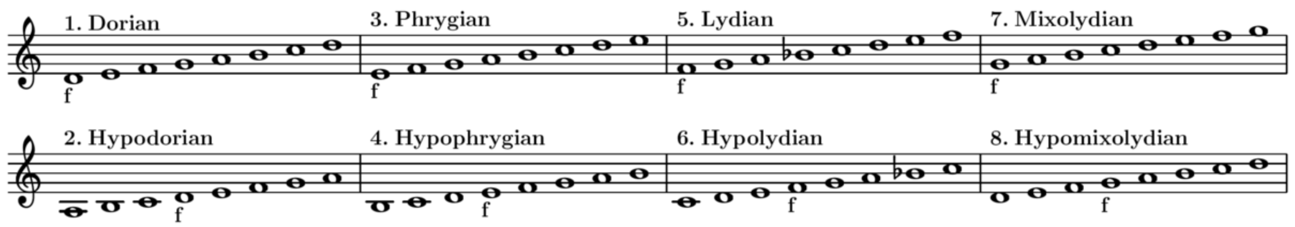
Ancient Greek Lydian



Diatonic genus of the Ancient Greek Lydian scale on C Play.

The name Lydian refers to the ancient kingdom of Lydia in Anatolia. In Greek music theory, there was a Lydian scale or "octave species" extending from *parhypate hypaton* to *trite diezeugmenon*, equivalent in the diatonic genus to the modern major scale: C D E F | G A B C. (In the chromatic and enharmonic genera, the Lydian scale was equivalent to C D♯ E F | G A♯ B C and C E E‡ F | G B B‡ C, respectively, where "‡" signifies raising the pitch by approximately a quarter tone) (Barbera 1984, 240). Placing the two tetrachords together, and the single tone at bottom of the scale produces the Hypolydian mode (below Lydian): F | G A B C | (C) D E F. Placing the two tetrachords together, and the single tone at the top of the scale produces the Hyperlydian mode (above Lydian), which is effectively the same as the Hypophrygian mode: G A B C | (C) D E F | G.

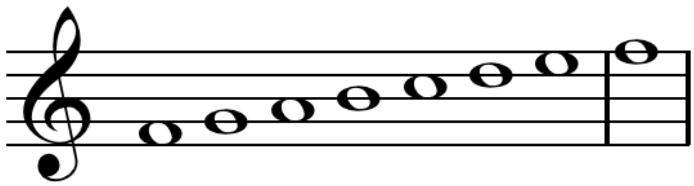
Medieval Lydian mode



The eight Gregorian modes: **f** indicates 'final'

In the Middle Ages and Renaissance, this mode was described in two ways. The first way is the diatonic octave species from F up to F an octave above, divided at C to produce two segments: F–G–A–B–C and C–D–E–F. The second is as a mode with a final on F and an ambitus extending to F an octave higher and in which the note C was regarded as having an important melodic function. Many theorists of the period observed that B♭ is used more typically than B♮ in compositions in Lydian mode (Powers 2001).

Modern Lydian mode



Modern Lydian scale on F Play.

The Lydian scale can be described as a major scale with the fourth scale degree raised a semitone, e.g., a C-major scale with an F♯ rather than F♮.

Triads within Lydian mode

In Lydian mode, the tonic, dominant, and supertonic triads are all major. The subdominant is diminished. The triads built on the remaining three scale degrees are minor.

Modern usage of Lydian mode

A rare, extended use of the Lydian mode in the Classical repertoire is Simon Sechter's 1822 *Messe in der lydische Tonart* (Mass in the Lydian Mode) (Carver 2005, 76). A more famous example from around the same time is the third movement of Ludwig van Beethoven's String Quartet No. 15 in A minor, Op. 132 (1825), titled by the composer "Heiliger Dankgesang eines Genesenen an die Gottheit, in der lydischen Tonart" ("Holy Song of Thanksgiving by a Convalescent to the Divinity, in the Lydian Mode"). The alternating passages in F use the Lydian scale with sharp fourth scale degree exclusively. Anton Bruckner employed the Lydian scale is his motet *Os justi* (1879) more strictly than Renaissance composers ever did when writing in this mode (Carver 2005, 74–75).

References

- Barbera, André. 1984. "Octave Species". *Journal of Musicology* 3, no. 3 (July): 229–41. http://www.jstor.org/stable/763813 (Subscription access) doi:10.1525/jm.1984.3.3.03a00020
- Benward, Bruce, and Marilyn Nadine Saker. 2009. *Music in Theory and Practice*, eighth edition, vol. 2. Boston: McGraw-Hill. ISBN 978-0-07-310188-0.
- Carver, Anthony F. 2005. "Bruckner and the Phrygian Mode". *Music and Letters* 86, no. 1:74–99. doi:10.1093/ml/gci004 (Subscription access)
- Jones, George Thaddeus. 1974. *Music Theory: The Fundamental Concepts of Tonal Music Including Notation, Terminology, and Harmony*. Barnes & Noble Outline Series 137. New York, Hagerstown, San Francisco, London: Barnes & Noble. ISBN 978-0-06-40137-4.
- Miller, Scott. 2002. *Mel Bay's Getting Into … Jazz Fusion Guitar*. Pacific, Missouri: Mel Bay Publications. ISBN 0786662484.
- Powers, Harold S. 2001. "Lydian". *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell, 15:409–10. 29 vols. London: Macmillan Publishers. ISBN 978-1-56159-239-5 (set) ISBN 978-0-19517-067-2 (set) OCLC 44391762 (set) OCLC 248649842 (v. 15) OCLC 249589729 (v. 15, reprint with minor corr.) LCCN 00-55156 or 00055156 (set)

External links

- Lydian mode in six positions for guitar [1] at GOSK.com

References

[1] http://gosk.com/scales/lydian-scale-for-guitar.php

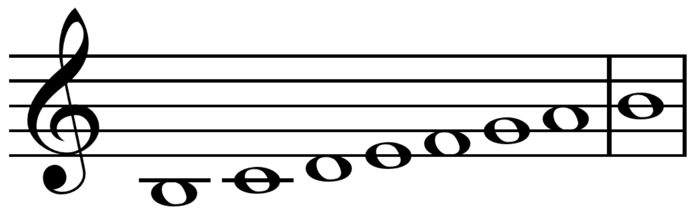
Mixolydian mode

Mixolydian mode may refer to one of three things: the name applied to one of the ancient Greek *harmoniai* or *tonoi*, based on a particular octave species or scale; one of the medieval church modes; a modern musical mode or diatonic scale, related to the medieval mode.

Modern Mixolydian scale on C[1] Play.

Greek Mixolydian

The idea of a Mixolydian mode comes from the music theory of ancient Greece. The ancient Greek Mixolydian mode was invented by Sappho, the 7th century B.C. poet and musician.[2] However, what the ancient Greeks thought of as Mixolydian was very different from the modern interpretation of the mode.



Diatonic genus of the Greek Mixolydian scale on B Play.

In Greek theory, the Mixolydian mode (or *tonos*) employs a scale (or 'octave species') corresponding to the Greek Hypolydian mode inverted: in its diatonic genus, this is a scale descending from *paramese* to *hypate hypaton*: in the diatonic genus, a whole tone (*paramese* to *mese*) followed by two conjunct inverted Lydian tetrachords (each being two whole tones followed by a semitone descending). This is the equivalent of playing all the 'white notes' of a piano from B to B, or B | A G F E | (E) D C B, which is also known as a modern locrian mode. (In the chromatic and enharmonic genera, each tetrachord consists of a minor third plus two semitones, and a major third plus two quarter-tones, respectively).[3]

Medieval Mixolydian and Hypomixolydian

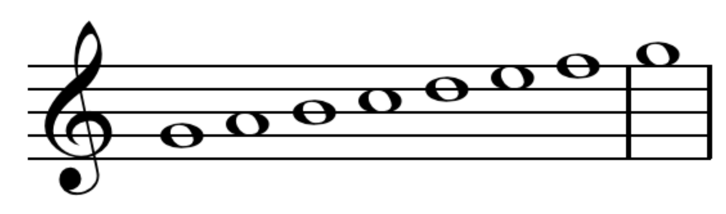
Originally used to designate one of the traditional *harmoniai* of Greek theory, the name was appropriated (along with six others) by the 2nd-century theorist Ptolemy to designate his seven *tonoi*, or transposition keys. Four centuries later, Boethius interpreted Ptolemy in Latin, still with the meaning of transposition keys, not scales. When chant theory was first being formulated in the 9th century, these seven names plus an eighth, Hypermixolydian (later changed to Hypomixolydian), were again re-appropriated in the anonymous treatise *Alia Musica*. A commentary on that treatise, called the *Nova expositio*, first gave it a new sense as one of a set of eight diatonic species of the octave, or scales.[4] The name *Mixolydian* came to be applied to one of the eight modes of medieval church music: the seventh mode. This mode does not run from B to B on white notes, as the Greek mode, but was defined in two ways: as the diatonic octave species from G up one octave to the G above, or as a mode whose final was G and whose ambitus runs from the F below the final to the G above, with possible extensions "by licence" up to A above and even down to E below, and in which the note D (the tenor of the corresponding seventh psalm tone) had an important melodic function.[5] This medieval theoretical construction led to the modern use of the term for the natural scale from G to G.

The seventh mode of western church music is an authentic mode based on and encompassing the natural scale from G to G, with the perfect fifth (the D in a G to G scale) as the dominant, reciting note or *tenor*.

The plagal eighth mode was termed Hypomixolydian (or "lower Mixolydian") and, like the Mixolydian, was defined in two ways: as the diatonic octave species from D to the D an octave higher, divided at the mode final, G (thus D–E–F–G + G–A–B–C–D); or as a mode with a final of G and an ambitus from C below the final to E above it, in which the note C (the tenor of the corresponding eighth psalm tone) had an important melodic function.[6]

Modern Mixolydian

This modern scale has the same series of tones and semitones as the major scale, except the seventh degree is a semitone lower.[1] The Mixolydian mode is sometimes called the **dominant scale**,[7] because it is the mode built on the fifth degree (the dominant) of the major scale.



Modern Mixolydian scale on G Play.

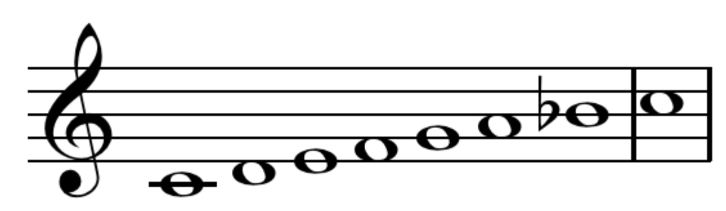
The order of tones and semitones in a Mixolydian scale is TTSTTST (T = tone; S = semitone), while the major scale is TTSTTTS. The key signature varies accordingly (it will be the same as that of the major key a fifth below).[1]

Some examples:

- The G Mixolydian mode (Related to the key of C major - on a piano it is all the white keys from one G to the next. GABCDEFG)[1]
- The C Mixolydian mode (Related to the key of F major. CDEFGAB♭C)[1]
- The D Mixolydian mode (Related to the key of G major. DEF♯GABCD)[1]
- The E Mixolydian mode (Related to the key of A major. EF♯G♯ABC♯DE)[1]

Moloch scale

Moloch scale is the name used by Klezmer musicians for the Mixolydian scale, with which it is identical. In Klezmer, it is usually transposed to C, where the main chords used are C, F, and G7 (sometimes Gm).[8]



Moloch scale on C. Play.

Notable songs in Mixolydian mode

- "Old Joe Clark"[9] [10]
- "She Moved Through the Fair"[11]
- "Let It Loose"[12] by The Rolling Stones
- "Sweet Home Alabama" by Lynyrd Skynyrd[10]
- Introduction to "Sweet Child o' Mine" by Guns N' Roses[13]
- "Marquee Moon" by Television[14] [15]
- "Norwegian Wood" by The Beatles[10] [16] [17]
- The Allman Brothers Band's "Ramblin' Man" (with blues flavoring)[17]

References

[1] Arnie Berle, " The Mixolydian Mode/Dominant Seventh Scale (http://books.google.com/books?id=5YpeM9mTRIAC&pg=PA33)", in *Mel Bay's Encyclopedia of Scales, Modes and Melodic Patterns: A Unique Approach to Developing Ear, Mind and Finger Coordination* (Pacific, Missouri: Mel Bay Publications, 1997): p. 33. ISBN 978-0-7866-1791-3 OCLC 48534968

[2] Anne Carson (ed.), *If Not, Winter: Fragments of Sappho* (New York: Vintage Books, 2002), p. ix. ISBN 978-0375724510. Carson cites Pseudo-Plutarch, *On Music* 16.113c, who in turn names Aristoxenus as his authority.

[3] Thomas J. Mathiesen, "Greece", *The New Grove Dictionary of Music and Musicians*, second edition, 29 vols., edited by Stanley Sadie and John Tyrrell, 10: (London: Macmillan Publishers, 2001), 10:339. ISBN 1-56159-239-0 OCLC 44391762.

[4] Harold S. Powers, "Dorian", *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrell (London: Macmillan Publishers, 2001).

[5] Harold S. Powers and Frans Wiering, "Mixolydian", *The New Grove Dictionary of Music and Musicians*, second edition, 29 vols., edited by Stanley Sadie and John Tyrell, 16:766–67 (London: Macmillan Publishers, 2001), 767. ISBN 978-1-56159-239-5.

[6] Harold S. Powers and Frans Wiering, "Hypomixolydian", *The New Grove Dictionary of Music and Musicians*, second edition, 29 vols., edited by Stanley Sadie and John Tyrell, 12:38 (London: Macmillan Publishers, 2001) ISBN 978-1-56159-239-5.

[7] Dan Haerle, *Scales for Jazz Improvisation* (Hialeah: Columbia Pictures Publications; Lebanon, Indiana: Studio P/R; Miami: Warner Bros, 1983), p. 15. ISBN 9780898987058.

[8] Dick Weissman and Dan Fox, *A Guide to Non-Jazz Improvisation: Guitar Edition* (Pacific, Missouri: Mel Bay Publications, 2009): p. 130. ISBN 9780786607518.

[9] Wendy Anthony, " Building a Traditional Tune Repertoire: Old Joe Clark (Key of A-Mixolydian) (http://archive.mandolinsessions.com/feb07/Anthony.html)", *Mandolin Sessions* webzine (February 2007) |(Accessed 2 February 2010).

[10] Ted Eschliman, " Something Old. Something New (http://www.mandolinsessions.com/?p=460)", *Mandolin Sessions* webzine (November 2009) (Accessed 2 February 2010).

[11] Patrick Allen, *Developing Singing Matters* (Oxford: Heinemann Educational Publishers, 1999): p. 22 (http://books.google.com/books?id=pUycX-MTVHQC&printsec=frontcover&source=gbs_summary_r&cad=0#PRA2-PA22-IA2,M1). ISBN 0-435-81018-9 OCLC 42040205

[12] Jack Morer, *Rolling Stones: "Exile on Main Street"* (Milwaukee: Hal Leonard Corporation, 1995): p. 100. ISBN 0-7935-4094-1 OCLC 49627026

[13] Dan Bennett, "The Mixolydian Mode", in *The Total Rock Bassist* (http://books.google.com/books?id=vRgI4W_dN5IC&pg=PA90) (Van Nuys and Los Angeles: Alfred Publishing, 2008): p. 90. ISBN 978-0-7390-5269-3 OCLC 230193269

[14] " Marquee Moon tab (http://zappa.brainiac.com/tab/marquee.tab.txt)", *Joe Hartley's generic homepage*.

[15] Rooksby, Rikky (2001). *Inside Classic Rock Tracks*, p.86. ISBN 9780879306540.

[16] Kenneth Womack and Todd F. Davis, *Reading the Beatles: Cultural Studies, Literary Criticism, and the Fab Four* (Albany: State University of New York Press, 2006): p. 45. ISBN 9780791467152 (cloth); ISBN 9780791467169 (pbk).

[17] Stephenson, Ken (2002). *What to Listen for in Rock: A Stylistic Analysis*, p.39. ISBN 9780300092394.

External links

- "Mixolydian scale for guitar" (http://gosk.com/scales/mixolydian-scale-for-guitar.php). The Guitarist's Online Survival Kit. Retrieved 27 June 2008.
- "Edmund Fitzgerald Chords by Gordon Lightfoot, www.Ultimate-Guitar.Com" (http://www.911tabs.com/link/?5390272). www.Ultimate-Guitar.Com. Retrieved 30 November 2009.

SynthLab Technical Elements

Low-frequency oscillation

Low-frequency oscillation **(LFO)** is an electronic signal, which is usually below 20 Hz and creates a rhythmic pulse or sweep. This pulse or sweep is often used to modulate synthesizers, delay lines and other audio equipment in order to create effects used in the production of electronic music. Audio effects such as vibrato, tremolo and phasing are examples. The abbreviation is also very often used to refer to **low-frequency oscillators** themselves.

LFO section of a modern synthesizer

History

Low-frequency oscillation as a concept was first introduced in the modular synths of the 1960s and 70s. Often the LFO effect was accidental; so myriad were the number of configurations that could be 'patched' by the synth operator. LFOs have since appeared in some form on almost every synthesizer. More recently other electronic instruments, such as samplers and software synthesizers, have included LFOs to increase their sound alteration capabilities.

Overview

The primary oscillator circuits of a synthesizer are used to create the audio signals. An LFO is a secondary oscillator that operates at a significantly lower frequency (hence its name), typically below 20hz. This lower frequency or control signal is used to modulate another component's value, changing the sound without introducing another source. Like a standard oscillator, this usually takes the form of a periodic waveform, such as a sine, sawtooth, triangle or square wave. Also like a standard oscillator, LFOs can incorporate any number of waveform types, including user-defined wavetables, rectified waves and random signals.

Using a low-frequency oscillation signal as a means of modulating another signal introduces complexities into the resulting sound, such that a variety of effects can be achieved. The specifics vary greatly depending on the type of modulation, the relative frequencies of the LFO signal and the signal being modulated, et cetera.

Uses

An LFO can be routed to control, for example, the frequency of the audio oscillator, its phase, stereo panning, filter frequency, or amplification. When routed to control pitch, an LFO creates vibrato. When an LFO modulates amplitude (volume), it creates tremolo. On most synthesizers and sound modules, LFOs feature several controllable parameters, which often include a variety of different waveforms, a rate control, routing options (as described above), a tempo sync feature, and an option to control how much the LFO will modulate the audio signal.

Electronic musicians use LFO for a variety of applications. They may be used to add simple vibrato or tremolo to a melody, or for more complex applications such as triggering gate envelopes, or controlling the rate of arpeggiation.

Differences between LFO rates also account for a number of commonly heard effects in modern music. A very low rate can be used to modulate a filter's cutoff frequency, thereby providing the characteristic gradual sensation of the sound becoming clearer or closer to the listener. Alternatively, a high rate can be used for bizarre 'rippling' sound effects (indeed, another important use of LFO would be for various sound effects used in films). Such effects are difficult to describe, and are more understandable when heard. Dubstep is a form of electronic music that employs heavy use of LFOs for bass sounds that have a "generic wobble" effect.

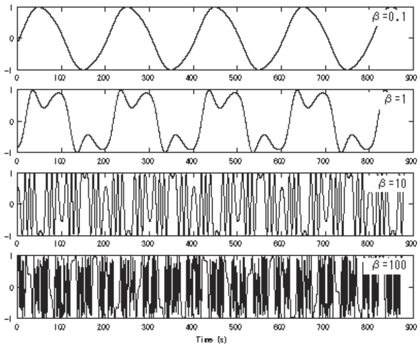
Other notes

The British electronic music group LFO take their name directly from the low-frequency oscillator.[1]

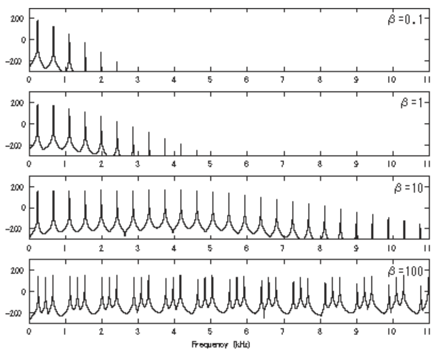
References

[1] "LFO biography" (http://www.allmusic.com/artist/lfo-p13499/biography). Allmusic. . Retrieved 2011-07-27. "Taking their name from the foundational component of the synthesizers -- the low frequency oscillator (kind of like calling a rock group 'Power Chord')"

Frequency modulation synthesis



A 220 Hz carrier tone modulated by a 440 Hz modulating tone with various choices of modulation index, β. The time domain signals are illustrated above, and the corresponding spectra are shown below (spectrum amplitudes in dB).



In audio and music **frequency modulation synthesis** (or **FM synthesis**) is a form of audio synthesis where the timbre of a simple waveform is changed by frequency modulating it with a modulating frequency that is also in the audio range, resulting in a more complex waveform and a different-sounding tone. The frequency of an oscillator is altered or distorted, "in accordance with the amplitude of a modulating signal." (Dodge and Jerse 1997, p.115)

For synthesizing harmonic sounds, the modulating signal must have a harmonic relationship to the original carrier signal. As the amount of frequency modulation increases, the sound grows progressively more complex. Through the use of modulators with frequencies that are non-integer multiples of the carrier signal (i.e. non harmonic), bell-like dissonant and percussive sounds can easily be created.

History

The technique, which was discovered by John Chowning (Chowning 1973, cited in Dodge and Jerse, p.115) at Stanford University in 1967-68, was patented in 1975 and later licensed to Yamaha.

The implementation commercialized by Yamaha (US Patent 4018121 Apr 1977 [1] or U.S. Patent 4,018,121 [2]) is actually based on phase modulation.

FM synthesis is very good at creating both harmonic and inharmonic ("clang", "twang" or "bong" noises) sounds. Complex (and proper) FM synthesis using analog oscillators is not generally feasible due to their inherent pitch instability, but FM synthesis (using the frequency stable phase modulation variant) is easy to implement digitally. As a result, FM synthesis was the basis of some of the early generations of digital synthesizers from Yamaha, with Yamaha's flagship DX7 synthesizer being ubiquitous throughout the 1980s. Yamaha had patented its hardware implementation of FM, allowing it to nearly monopolize the market for that technology. Casio developed a related form of synthesis called phase distortion synthesis, used in its CZ series of synthesizers. It had a similar (but slightly differently derived) sound quality as the DX series.

Don Buchla implemented FM on his instruments in the mid-1960s, prior to Yamaha's patent. His 158, 258 and 259 dual oscillator modules had a specific FM control voltage input, and the model 208 (Music Easel) had a modulation oscillator hard-wired to allow FM as well as AM of the primary oscillator. These early applications used analog oscillators.

With the expiration of the Stanford University FM patent in 1995, FM synthesis is now part of the synthesis repertoire of most modern synthesizers, usually in conjunction with additive, subtractive and sometimes sampling techniques. The FM synthesis patent brought Stanford $20 million dollars before it expired, making it (in 1994) "the second most lucrative licensing agreement in Stanford's history".[3]

Functioning

The harmonic distribution of a simple sine wave signal modulated by another sine wave signal can be represented with Bessel functions – this provides a basis for a simple mathematical understanding of FM synthesis.

FM synthesis is a form of "distortion synthesis" or "nonlinear synthesis". It begins with an oscillator generating an audio-frequency "carrier" waveform with a frequency of F_c. An audio-frequency modulating waveform, with a frequency F_m, is then applied to change or "modulate" the frequency of the carrier oscillator.

If the amplitude of the modulator is 0, the output frequency of the carrier oscillator is simply F_c . Otherwise, the amplitude of the modulating signal causes the frequency of the carrier oscillator to swing above and below F_c . This frequency swing is known as "deviation".

In simple terms, the stronger (higher in amplitude) the modulating signal is, the more the carrier frequency changes. For illustration, suppose F_c is 1000 Hz. Modulation amplitude might be applied that causes the carrier to swing between 900 Hz and 1100 Hz, that is, 100 Hz in either direction. This is termed a "deviation" of 100 Hz.

At the same time, the frequency of the modulating signal causes *sideband* signals to appear at frequencies above and below the carrier frequency. Therefore for each frequency component in the modulating signal, an *upper sideband* appears above F_c, and a *lower sideband* appears below F_c. A complex modulating waveform (containing more partials than a simple sinewave) will create sidebands corresponding to each of its sinewave components.

Deviation (d) is partly responsible for the power of each component of the output audio signal. When d=0, all the power is heard at the carrier frequency. The larger the deviation, the more power is shifted to the sidebands.

The ratio of deviation to modulation frequency is called the "index of modulation". ($I = d / F_m$) This ratio controls the spectral richness of the sound. By varying deviation through modulation amplitude, and varying the spectrum of the modulating waveform, the resulting audio can be evolved without further instrument complexity. This is the power of FM synthesis.

References

[1] http://patft.uspto.gov/netacgi/nph-Parser?patentnumber=4018121

[2] http://www.google.com/patents/about?id=GNEzAAAAEBAJ&dq=

[3] Stanford University News Service (06/07/94), Music synthesis approaches sound quality of real instruments (http://news.stanford.edu/pr/94/940607Arc4222.html)

- J. Chowning (1973). "The Synthesis of Complex Audio Spectra by Means of Frequency Modulation". *Journal of the Audio Engineering Society* **21** (7).
- Chowning, John; Bristow, David (1986). *FM Theory & Applications - By Musicians For Musicians*. Tokyo: Yamaha. ISBN 4-636-17482-8.
- Dodge, Charles; Jerse, Thomas A. (1997). *Computer Music: Synthesis, Composition and Performance*. New York: Schirmer Books. ISBN 0-02-864682-7.

External links

- An Introduction To FM (http://ccrma.stanford.edu/software/snd/snd/fm.html), by Bill Schottstaedt
- FM tutorial (http://www.sfu.ca/~truax/fmtut.html)
- SOUNDSHOCK, an English language discussion forum dedicated exclusively to FM Synthesis (http://www.soundshock.se/)
- Article: FM Synthesis (http://www.sospubs.co.uk/sos/apr00/articles/synthsecrets.htm)
- Paul Wiffens Synth School: Part 3 (http://www.soundonsound.com/sos/1997_articles/sep97/synthschool3.html)
- F.M. Synthesis including complex operator analysis (http://yala.freeservers.com/2fmsynth.htm#2Mod)
- Part 1 of a 2-part YouTube tutorial on FM synthesis with numerous audio examples (http://www.youtube.com/watch?v=h3yrd2YvkUo)

Voltage-controlled oscillator

A **voltage-controlled oscillator** or **VCO** is an electronic oscillator designed to be controlled in oscillation frequency by a voltage input. The frequency of oscillation is varied by the applied DC voltage, while modulating signals may also be fed into the VCO to cause frequency modulation (FM) or phase modulation (PM); a VCO with digital pulse output may similarly have its repetition rate (FSK, PSK) or pulse width modulated (PWM).

Types of VCOs

A microwave (12-18 GHz) Voltage Controlled Oscillator

VCOs can be generally categorized into two groups based on the type of waveform produced: 1) harmonic oscillators, and 2) relaxation oscillators.

Harmonic oscillators generate a sinusoidal waveform. They consist of an amplifier that provides adequate gain and a resonant circuit that feeds back signal to the input. Oscillation occurs at the resonant frequency where a positive gain arises around the loop. Some examples of harmonic oscillators are crystal oscillators and LC-tank oscillators. When part of the resonant circuit's capacitance is provided by a varactor diode, the voltage applied to that diode varies the frequency.

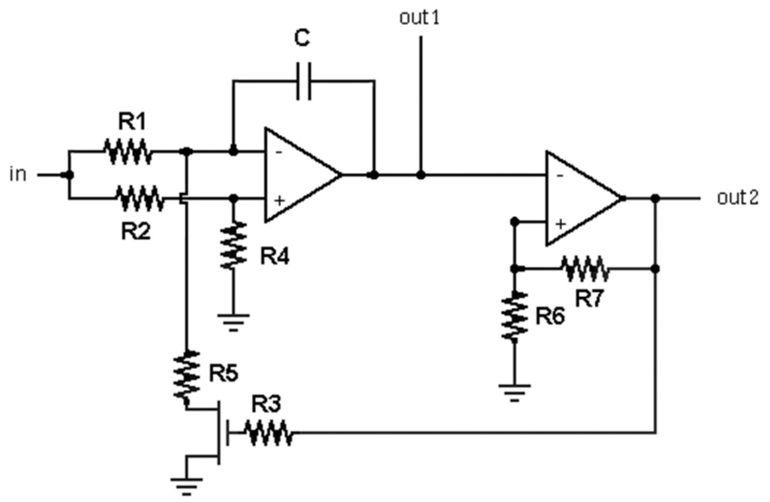
Relaxation oscillators can generate a sawtooth or triangular waveform. They are commonly used in monolithic integrated circuits (ICs). They can provide a wide range of operational frequencies with a minimal number of external components. Relaxation oscillator VCOs can have three topologies: 1) grounded-capacitor VCOs, 2) emitter-coupled VCOs, and 3) delay-based ring VCOs. The first two of these types operate similarly. The amount of time in each state depends on the time for a current to charge or discharge a capacitor. The delay-based ring VCO operates somewhat differently however. For this type, the gain stages are connected in a ring. The output frequency is then a function of the delay in each of stages.

Harmonic oscillator VCOs have these advantages over relaxation oscillators.

- Frequency stability with respect to temperature, noise, and power supply is much better for harmonic oscillator VCOs.
- They have good accuracy for frequency control since the frequency is controlled by a crystal or tank circuit.

A disadvantage of harmonic oscillator VCOs is that they cannot be easily implemented in monolithic ICs. Relaxation oscillator VCOs are better suited for this technology. Relaxation VCOs are also tunable over a wider range of frequencies.

Control of frequency in VCOs



Voltage-controlled oscillator schematic - audio

A voltage-controlled capacitor is one method of making an LC oscillator vary its frequency in response to a control voltage. Any reverse-biased semiconductor diode displays a measure of voltage-dependent capacitance and can be used to change the frequency of an oscillator by varying a control voltage applied to the diode. Special-purpose variable capacitance varactor diodes are available with well-characterized wide-ranging values of capacitance. Such devices are very convenient in the manufacture of voltage-controlled oscillators[1] For low-frequency VCOs, other methods of varying the frequency (such as altering the charging rate of a capacitor by means of a voltage controlled current source) are used. See Function generator.

The frequency of a ring oscillator is controlled by varying either the supply voltage or the capacitive loading on each stage.

Voltage-controlled crystal oscillators

A **voltage-controlled crystal oscillator** (**VCXO**) is used when the frequency of operation needs to be adjusted only finely. The frequency of a voltage-controlled crystal oscillator can be varied only by typically a few tens of parts per million (ppm), because the high Q factor of the crystals allows "pulling" over only a small range of frequencies.

There are two reasons for using a VCXO:

- To adjust the output frequency to match (or perhaps be some exact multiple of) an accurate external reference.
- Where the oscillator drives equipment that may generate radio-frequency interference, adding a varying voltage to its control input can disperse the interference spectrum to make it less objectionable. See spread-spectrum clock generation.

A **temperature-compensated VCXO** (**TCVCXO**) incorporates components that partially correct the dependence on temperature of the resonant frequency of the crystal. A smaller range of voltage control then suffices to stabilize the oscillator frequency in applications where temperature varies, such as heat buildup inside a transmitter.

VCO time-domain equations

$$f_{tuning}(t) = K_o \cdot \ v_{in}(t)$$

$$\int f_{tuning}(t)\, dt = \theta_{out}(t)$$

- K_o is called the oscillator gain. Its units are hertz per volt.
- $f_{tuning}(t)$ is the symbol for the time-domain waveform that is the VCO's tunable frequency component.
- $\theta_{out}(t)$ is the symbol for the time-domain waveform that is the VCO's output phase.
- $v_{in}(t)$ is the time-domain symbol of the control (input) voltage of the VCO; it is sometimes also represented as $v_{tune}(t)$

VCO freq-domain equations

$$F_{tuning}(s) = K_o \cdot \ V_{in}(s)$$
$$\frac{F_{tuning}(s)}{s} = \Theta_{out}(s)$$

VCO design and circuits

Tuning range, tuning gain and phase noise are the most important factors of the basic design of a VCO. Generally low phase noise is preferred in the VCO. The important elements that determine the phase noise of an oscillator are the material,[2] transistor's flicker noise corner frequency, the loaded Q of the resonator and the final signal to noise ratio.

Most commonly used VCO circuits are the Clapp and Colpitts oscillators. The more widely used oscillator of the two is Colpitts and these oscillators are very similar in configuration.

VCOs generally have the lowest Q-factor of the used oscillators, and so suffer more jitter than the other types. The jitter can be made low enough for many applications (such as driving an ASIC), in which case VCOs enjoy the advantages of having no off-chip components (expensive) or on-chip inductors (low yields on generic CMOS processes). These oscillators also have larger tuning ranges than the other kinds, which improves yield and is sometimes a feature of the end product (for instance, the dot clock on a graphics card which drives a wide range of monitors).

Applications

VCOs are used in:

- Electronic jamming equipment
- Function generators,
- The production of electronic music, to generate variable tones,
- Phase-locked loops,
- Frequency synthesizers used in communication equipment.

Voltage-Controlled Crystal Oscillator as a Clock Generator

A clock generator is an oscillator that provides a timing signal to synchronize operations in digital circuits. VCXO clock generators are used in many areas such as digital TV, modems, transmitters and computers. Design parameters for a VCXO clock generator are tuning voltage range, center frequency, frequency tuning range and the timing jitter of the output signal. Jitter is a form of phase noise that must be minimised in applications such as radio receivers, transmitters and measuring equipment.

The tuning range of a VCXO is typically a few ppm (parts per million) corresponding to a control voltage range of typically 0 to 3 volts. When a wider selection of clock frequencies is needed the VCXO output can be passed through digital divider circuits to obtain lower frequency(ies) or be fed to a PLL (Phase Locked Loop). ICs containing both a VCXO (for external crystal) and a PLL are available. A typical application is to provide clock frequencies in a range from 12 kHz to 96 kHz to an audio digital to analog converter.

Chips

- LM231, LM331 are VCOs (Precision Voltage-to-Frequency Converters, NS).
- VCOs can be found in the TTL 74124 Dual VCO and the CMOS 4046 PLL.

Notes

[1] A voltage-controlled inductor would be in principle as useful, but such devices are unsatisfactory at the frequencies usually desired.
[2] Wideband VCO (http://www.herley.com/index.cfm?act=product&prd=481) from Herley - General Microwae - "For optimum performance, the active element used is a silicon bipolar transistor. (This is in lieu of GaAs FETs which typically exhibit 10-20 dB poorer phase noise performance)"

References

External links

- schematics (http://my.integritynet.com.au/purdic/voltage-controlled-oscillators.htm)
- Designing VCOs and Buffers Using the UPA family of Dual Transistors (http://www.cel.com/pdf/appnotes/an1034.pdf)

Carrier wave

In telecommunications, a **carrier wave**, or **carrier** is a waveform (usually sinusoidal) that is modulated (modified) with an input signal for the purpose of conveying information.[1] This carrier wave is usually of much higher frequency than the input signal. The purpose of the carrier is usually either to transmit the information through space as an electromagnetic wave (as in radio communication), or to allow several carriers at different frequencies to share a common physical transmission medium by frequency division multiplexing (as is used in, for example, a cable television system).

Frequency modulation (FM) and amplitude modulation (AM) are commonly used methods to modulate the carrier. In the case of single-sideband modulation (SSB) the carrier is suppressed (and in some forms of SSB eliminated). The carrier must be reintroduced at the receiver by a beat frequency oscillator (BFO).

The frequency for a given radio or television station is actually the carrier wave's center frequency.

Definition

In telecommunication, the term **carrier** (**cxr**) or **carrier wave** has the following meanings:[2]

1. A waveform suitable for modulation by an information-bearing signal.
2. An unmodulated emission. *Note:* The carrier is usually a sinusoidal wave or a uniform or predictable series of pulses. *Synonym:* carrier wave.
3. Sometimes employed as a synonym for a carrier system, or a synonym for a telecommunications provider company (operator), such as a common carrier.

Carrierless modulation systems

Newer forms of radio communication, such as spread spectrum and ultra-wideband, do not transmit a conventional carrier wave, nor does OFDM, which is used in DSL and in the European standard for HDTV.

- OFDM should be thought of as an array of symmetrical carrier waves. The rules governing carrier wave propagation affect OFDM differently than 8VSB.
- Some forms of spread spectrum transmission and most forms of ultra-wideband transmission are mathematically defined as being devoid of carrier waves. Transmitter implementations typically produce residual carriers that may or may not be detectable or transmitted.

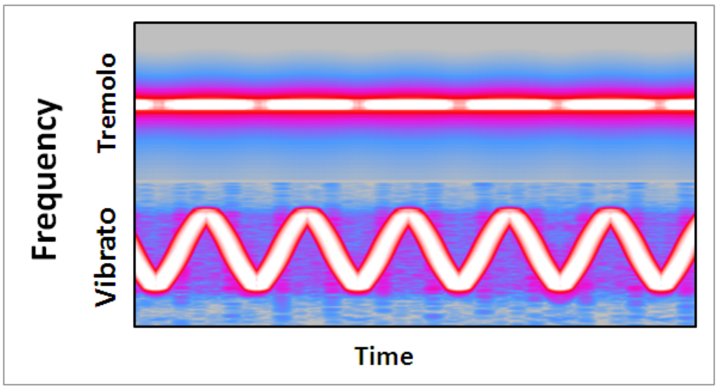
References

[1] "Carrier wave with no modulation transports no information." (http://www.utexas.edu/research/cemd/nim/Agif/CarrWave.html). *University Of Texas*. . Retrieved 2008-05-30.
[2] Federal Standard 1037C and MIL-STD-188

Vibrato

Vibrato is a musical effect consisting of a regular pulsating change of pitch. It is used to add expression to vocal and instrumental music. Vibrato is typically characterised in terms of two factors: the amount of pitch variation ("extent of vibrato") and speed with which the pitch is varied ("rate of vibrato").[1]

Vibrato and tremolo



Spectrogram illustrating the difference between tremolo and vibrato.

The terms vibrato and tremolo are sometimes used interchangeably, although the strict definitions of each describe them as separate effects: vibrato is a periodic variation in the pitch (frequency) of a musical note, whereas tremolo usually refers to periodic variations in the volume (amplitude) of a musical note. In practice, it is difficult for a singer or musical instrument player to achieve a pure vibrato or tremolo (where only the pitch or only the volume is varied), and variations in both pitch and volume will often be achieved at the same time. Electronic manipulation or generation of signals makes it easier to achieve or demonstrate pure tremolo and/or vibrato.

There are some instances where one of the terms (vibrato, tremolo) is used to describe the effect normally associated with the other term. For example, vibrato is sometimes referred to as *tremolo*, notably in referring to the vibrato arm of an electric guitar as a "tremolo arm", which produces variations of pitch. Conversely, the so-called vibrato unit built in to many guitar amplifiers produces what is known as tremolo in all other contexts. See *vibrato unit* for a detailed discussion of this terminology reversal.

Leslie speaker

A Leslie speaker (best known through its historical and popular association with the Hammond organ) creates vibrato as a byproduct of tremolo production. As a Leslie speaker is moved by the rotating mechanism on which it is mounted, it moves closer to or farther away from any given object (such as a listener's ears) not also mounted on the mechanism. Because amplitude varies directly with sound pressure ($A = k_1 P$) and sound pressure varies directly with distance ($P = k_2 d$), such that amplitude also varies directly with distance ($A = k_1(k_2 d) = k_1 k_2 d$), the amplitude of the sound as perceived by the listener will be greatest when the speaker is at the point in its rotation closest to the listener and least when the speaker is farthest away. Because the speaker is constantly moving either toward or away from the listener, however, the mechanism's rotation is constantly affecting the listener-perceived sound's wavelength by either "stretching" the wave (increasing wavelength) or "squeezing" it (decreasing wavelength) -- and because frequency, *i.e.*, pitch, is inversely proportional to wavelength, such that increasing wavelength decreases frequency and vice versa, any listener for whom the speaker's motion changes the sound's perceived amplitude (*i.e.*, any listener whose distance from the speaker is changing) must also perceive a change in frequency.

Acoustic basis

The use of vibrato is intended to add warmth to a note. In the case of many string instruments the sound emitted is strongly directional, particularly at high frequencies, and the slight variations in pitch typical of vibrato playing can cause large changes in the directional patterns of the radiated sound.[2] This can add a shimmer to the sound; with a well-made instrument it may also help a solo player to be heard more clearly when playing with a large orchestra.[3]

This directional effect is intended to interact with the room acoustics to add interest to the sound, in much the same way as an acoustic guitarist may swing the box around on a final sustain, or the rotating baffle of a Leslie speaker will spin the sound around the room.

Typical rate and extent of vibrato

The rate and extent of the variation in pitch during vibrato is controlled by the performer. The extent of vibrato for solo singers is usually less than a semitone (100 cents) either side of the note, while singers in a choir typically use narrower vibrato with an extent of less than +/- a tenth of a semitone (+/- 10 cents).[1] Wind and bowed instruments generally use vibratos with an extent of less than +/- half a semitone.[1]

Vibrato's use in various musical genres

Vibrato is sometimes thought of as an effect added onto the note itself, but in some cases it is so fully a part of the style of the music that it can be very difficult for some performers to play without it. The jazz tenor sax player Coleman Hawkins found he had this difficulty when requested to play a passage both with and without vibrato by the producer of a children's jazz album to demonstrate the difference between the two. Despite his technique, he was unable to play without vibrato. A symphony saxophonist was brought in to play the part.

Many classical musicians, especially singers and string players, have a similar problem. The violinist and teacher Leopold Auer, writing in his book *Violin Playing as I Teach It* (1920), advised violinists to practise playing completely without vibrato, and to stop playing for a few minutes as soon as they noticed themselves playing with vibrato in order for them to gain complete control over their technique.

In classical music

The use of vibrato in classical music is a matter of some dispute. For much of the 20th century it was used almost continuously in the performance of pieces from all eras from the Baroque onwards, especially by singers and string players. A drastic change in approach cannot be understood wholly without regarding the rise of notionally historically accurate ("period") performance from the 1970s onwards. However, there is no actual proof that singers performed without vibrato in the baroque era. Vocal music of the renaissance is almost never sung with vibrato as a rule, and it seems unlikely it ever was. There are only a few texts from the period on vocal production, but they all condemn the too frequent use of vibrato. However, it should be understood that "vibrato" occurs over a wide range of intensities: slow, fast, wide, and narrow. Most sources in condemning the practice seem to be referring to a wide, slow, perceptible oscillation in pitch, usually associated with intense emotion, whereas the ideal for modern vibrato, and possibly in earlier times as well, was to imitate the natural timbre of the adult singing voice, from which a measure of vibrato (it has since been shown) is rarely absent.

Leopold Mozart's *Versuch einer gründlichen Violinschule* (1756), for example, provides an indication of the state of vibrato in string playing at the end of the baroque period. In it, he concedes that "there are performers who tremble consistently on each note as if they had the permanent fever", condemning the practice, and suggesting instead that vibrato should be used only on sustained notes and at the ends of phrases when used as an ornament.[4] This however, does not give anything more than an indication of Mozart's own personal taste, based on the fact that he was an educated late Rococo/Classical composer. Mozart acknowledges the difference between the heavy, ornamental vibrato that he finds objectionable, and a more continuous application of the technique less obtrusively for purposes of improving tone quality (in which case he does not refer to it as "vibrato" or "tremolo" at all; describing it merely an aspect of correct fingering). In this respect he resembles his contemporary, Francesco Geminiani, who advocated using vibrato "as frequently as possible" on short notes for this purpose. Although there is no aural proof, as audio recordings were not around for more than 150 years, that string players in Europe did not use vibrato, its overuse was almost universally condemned by the leading musical authorities of the day.

Certain typtes of vibrato, then, were seen as an ornament, but this does not mean that it was used sparingly. In wind playing too, it seems that vibrato in music up to the 20th century was seen as an ornament to be used selectively. Martin Agricola writing in his *Musica instrumentalis deudch* (1529) writes of vibrato in this way. Occasionally, composers up to the baroque period indicated vibrato with a wavy line in the sheet music. Again, this does not suggest that it was not desired for the rest of the piece any more than the infrequent use of the term in 20th century works suggests that it is not used elsewhere.

Vibrato wars

Music by late Romantic composers such as Richard Wagner and Johannes Brahms is now played with a fairly continuous vibrato. However, some musicians specialising in historically informed performances such as the conductor Roger Norrington argue that it is unlikely that Brahms, Wagner, and their contemporaries would have expected it to be played in this way. This view has caused considerable controversy. The view that *continuous vibrato* was invented by Fritz Kreisler and some of his colleagues is held to be shown by early sound recordings, which allegedly demonstrate that vibrato appeared only in the 20th century. Against this are cited sources which are said to prove that early 19th-century Viennese string players like Franz Clement and Joseph Mayseder were noted for their tasteful use of vibrato. These musicians (and the two Hellmesbergers) are said to represent the school on which Fritz Kreisler based his stylistic approach.

The alleged growth of vibrato in 20th century orchestral playing has been traced by Norrington by studying early audio recordings but his opponents contend that his interpretations are not supported by the actual samples. Norrington claims that vibrato in the earliest recordings is used only selectively, as an expressive device; the Berlin Philharmonic Orchestra were not recorded using vibrato comparable to modern vibrato until 1935, and the Vienna Philharmonic Orchestra not until 1940. French orchestras seem to have played with continuous vibrato somewhat

earlier, from the 1920s.

Defenders of vibrato claim that the sonic limitations of 78-rpm recordings, particularly with respect to overtones and high frequency information, make an uncontroversial assessment of earlier playing techniques difficult (although, it must be said, early recordings of operatic singers manage to show clearly the extent to which a vibrato is present [or not] in their voices). In addition, the defenders of vibrato point out a distinction needs to be made between the kind of vibrato used by a solo player, and the sectional vibrato of an entire string ensemble, which cannot be heard as a uniform quantity as such. Rather, it manifests itself in terms of the warmth and amplitude of the sound produced, as opposed to a perceptible wavering of pitch. The fact that as early as the 1880s composers such as Richard Strauss (in his tone poems "Don Juan" and "Death and Transfiguration") as well as Camille Saint-Saëns (Symphony No. 3 "Organ") asked string players to perform certain passages "without expression" or "without nuance" strongly suggests the general use of vibrato within the orchestra as a matter of course.

Despite this, the use of vibrato in late Romantic music is still common, though challenged by Roger Norrington and others of the historically informed performance movement. Performances of composers from Beethoven to Arnold Schoenberg with limited vibrato are now not uncommon. Norrington caused controversy during the 2008 Proms season by conducting Edward Elgar's Enigma Variations, and the Last Night of the Proms, in non-vibrato style, which he calls *pure tone*. Some take the view that even though it may not be what the composer envisioned, vibrato adds an emotional depth which improves the sound of the music. Others feel that the leaner sound of vibratoless playing is preferable. In 20th century classical music, written at a time when the use of vibrato was widespread, there is sometimes a specific instruction *not* to use it (in some of the string quartets of Béla Bartók for example). Furthermore, some modern classical composers, especially minimalist composers, are against the use of vibrato at all times.

In opera

All human voices possess the capacity to produce a vibrato. This vibrato can be varied in width (and rapidity) through training. In opera, as opposed to pop, vibrato begins at the start of the note and continues to the end of the note with slight variations in width during the note.

Traditionally, however, the deliberate cultivation of a particularly wide, pervasive vibrato by opera singers from the Latin countries has been denounced by English-speaking music critics and pedagogues as a technical fault and a stylistic blot (see Scott, cited below, Volume 1, pp. 123–127). They have expected vocalists to emit a pure, steady stream of clear sound — irrespective of whether they were singing in church, on the concert platform, or on the operatic stage.

During the 19th century, for instance, New York and London based critics, including Henry Chorley, Herman Klein, and George Bernard Shaw, castigated a succession of visiting Mediterranean tenors for resorting to an excessive, constantly pulsating vibrato during their performances. Shaw called the worst offenders "goat bleaters" in his book *Music in London 1890-1894* (Constable, London, 1932). Among those censured for this failing were such celebrated figures as Enrico Tamberlik, Julián Gayarre, Roberto Stagno, Italo Campanini and Ernesto Nicolini—not to mention Fernando Valero and Fernando De Lucia, whose tremulous tones are preserved on the 78-rpm discs that they made at the beginning of the 20th century.

The popularity of an exaggerated vibrato among many (but by no means all) Mediterranean tenors and singing teachers of this era has been traced back by musicologists to the influential example set by the early-19th century virtuoso vocalist Giovanni Battista Rubini (1794–1854). Rubini had employed it with great success as an affecting device in the new Romantic operas of Gaetano Donizetti and Vincenzo Bellini. A host of young Italian tenors—including the renowned Giovanni Mario (1810–1883) — copied Rubini's trend-setting innovation in order to heighten the emotional impact of the music that they were singing, and to facilitate the delivery of fioritura "by, as it were, running up and down the vibrato" (to quote Scott; see p. 126).

Prior to the advent of the charismatic Rubini, every well-schooled opera singer had avoided using a conspicuous and continuous vibrato because, according to Scott, it varied the pitch of the note being sung to an unacceptable degree and it was considered to be an artificial contrivance arising from inadequate breath control. British and North American press commentators and singing teachers continued to subscribe to this view long after Rubini had come and gone.

Accordingly, when Enrico Caruso (1873–1921) — the most emulated Mediterranean tenor of the 20th century — made his acclaimed New York Metropolitan Opera debut in November 1903, one of the specific vocal attributes for which he was praised by music reviewers was the absence of a disruptive vibrato from his singing. The scholarly critic William James Henderson wrote in *The Sun* newspaper, for example, that Caruso "has a pure tenor voice and [it] is without the typical Italian bleat". Caruso's gramophone recordings support Henderson's assessment. (Other prominent Mediterranean tenors of the late 19th century-early 20th century who, like Caruso, did not "bleat" were Angelo Masini, Francesco Tamagno, Francesco Marconi, Francisco Viñas, Emilio De Marchi, Giuseppe Borgatti and Giovanni Zenatello, while the phenomenon was rare among French, German, Russian and Anglo-Saxon tenors of the same period—see Scott.)

The intentional use of a pronounced vibrato by Mediterranean tenors is a practice that has died out over the course of the past 100 years, owing in no small measure to Caruso's example. The last really important practitioners of this style and method of singing were Alessandro Bonci (in the 1900-1925 period) and Giacomo Lauri-Volpi (in the 1920-1950 period). Both of them featured bel canto works, dating from Rubini's day, in their operatic repertoires, and both of them can be heard on recordings which faithfully capture the distinct shimmer inherent in their timbre.

Italian or Spanish-trained operatic sopranos, mezzo-sopranos, and baritones exhibiting a pronounced vibrato did not escape censure, either, by British and North American arbiters of good singing. Indeed, Adelina Patti and Luisa Tetrazzini were the only Italian sopranos to enjoy star status in London and New York in the late-Victorian and Edwardian eras, while such well-known compatriots and coevals of theirs as Gemma Bellincioni and Eugenia Burzio (among several others) failed to please Anglo-Saxon ears because, unlike Patti and Tetrazzini, they possessed unsteady, vibrato-laden voices—see Scott for evaluations of their respective techniques. To give an additional female example from a later date, whenever the vivacious mezzo-soprano of the 1920s and '30s, Conchita Supervia, performed in London, she was admonished in print for her exceedingly vibrant and fluttery tone, which was unkindly likened by her detractors to the chatter of a machine-gun or the rattle of dice in a cup.

In 1883, Giuseppe Kaschmann (né Josip Kašman) — a principal baritone at La Scala, Milan—was criticised for his strong vibrato when he sang at the Met, and the theatre's management did not re-engage him for the following season, even though other aspects of his singing were admired. (Kaschmann never performed in Great Britain but he remained a popular artist in the Latin countries for several decades; in 1903, he made a few recordings which exhibit only too well his perpetual flutter.) Similarly, another one of Italy's leading baritones, Riccardo Stracciari, was unable to turn his pre-World War I London and New York operatic engagements into unambiguous triumphs due to an intrusive quiver in his tone. He subsequently moderated his vibrato, as the discs that he made for Columbia Records in 1917-1925 show, and this enabled him to pursue a significant career not only in his homeland but also at the Chicago opera.

There is another kind of vibrato-linked fault that can afflict the voices of operatic artists, especially ageing ones—namely the slow, often irregular wobble produced when the singer's vibrato has loosened from the effects of forcing, over-parting, or the sheer wear and tear on the body caused by the stresses of a long stage career.

References: For more information about the historical employment of vibrato by classical vocalists, see Michael Scott's two-volume survey *The Record of Singing* (published by Duckworth, London, in 1977 and 1979); John Potter's *Tenor: History of a Voice* (Yale University Press, New Haven & London, 2009); and Herman Klein's *30 Years of Music in London* (Century, New York, 1903).

In jazz

Most jazz players for the first half of the 20th century used vibrato more or less continuously. Since around the 1950s and the rise of bebop, continuous use of vibrato has largely fallen out of style in favor of more selective use.

In folk

Folk music singers and instrumentalists up to the present day rarely or never use vibrato. It tends only to be used by performers of transcriptions or reworkings of folk music that have been made by composers from a classical, music-school background such as Benjamin Britten or Percy Grainger.

The use of vibrato in some folk music is rare, or at least less pronounced than in other forms of music, although in Eastern European gypsy music, for example, it can be very wide.

In pop

In pop (as opposed to opera), where vibrato is used at all, the vibrato usually starts somewhere in the latter part of the note. In the case of some pop balladists, the vibrato can be so wide as to constitute a pronounced wobble, although not as pronounced as that present in some badly trained or over-worked operatic voices. Many singers use the vocoder in which the effect can be reduced or eliminated.

Techniques for producing vibrato

Not all instruments can produce vibrato, as some have fixed pitches which cannot be varied by sufficiently small degrees. Most percussion instruments are examples of this, for instance the xylophone.

Keyboard instruments

Some types of organ however, *can* produce the effect by altering the pressure of the air passing through the pipes, or by various mechanical devices (see the Hammond or Wurlitzer Organs for example). The clavichord, though technically a fixed-pitch keyboard instrument, is capable of producing a type of vibrato known as *Bebung* by varying the pressure on the key as the note sounds. Some digital keyboards can produce an electronic vibrato effect, either by pressure on the keys, or by using a joystick or other MIDI controller.

String instruments

The method of producing vibrato on other instruments varies. On string instruments, for example, the finger used to stop the string can be wobbled on the fingerboard, or actually moved up and down the string for a wider vibrato.

Many contemporary string players vary the pitch from below, only up to the nominal note and not above it,[5] although great violin pedagogues of the past such as Carl Flesch and Joseph Joachim explicitly referred to vibrato as a movement towards the bridge, meaning upwards in pitch,[6] —and the cellist Diran Alexanian, in his 1922 treatise *Traité théorique et pratique du Violoncelle*, shows how one should practice vibrato as starting from the note and then moving upwards in a rhythmic motion.[7] In a 1996 acoustic study by the Acoustical Society of America, along with Wellesley College and the Massachusetts Institute of Technology, found that the perceived pitch of a note with vibrato "is that of its mean", or the middle of the fluctuating pitch.[8]

The guqin, a Chinese bridgeless zither, has documents describing over 25 different types of vibrato that can be executed. Most peculiar is the vibrato *ting yin* (literally "still vibrato"); ancient manuals state that the finger on the left hand that is pressing the string should only move or rock ever so slightly so as to alter the pitch minutely, and some manuals say that the finger should not move at all but let the pulse of the finger do the vibrato.

Wide vibrato, as wide as a whole-tone, is commonly used among electric guitar players and adds a vocal-like expressiveness to the sound. This effect can be achieved both by the movement of fingers on the fretboard and by the use of a tremolo arm, a lever that adjusts the tension of the strings.

Wind instruments

Players of wind instruments generally create vibrato by modulating their air flow into the instrument. This may be accomplished either through stomach vibrato, the pulsing of the diaphragm slightly up and down, or throat vibrato, a variation of vocal chord tension to manipulate air pressure as singers do. Players of other instruments may employ less common techniques. Saxophonists tend to create vibrato by repeatedly moving their jaw up and down slightly. Clarinet players rarely play with vibrato, but if they do, the saxophone method is common because of the similarity of the saxophone and clarinet mouthpieces and reeds.

Brasses

Brass instrument players may produce vibrato by gently shaking the horn which varies the pressure of the mouthpiece against the lip. Alternatively, the embouchure can be rapidly altered, essentially repeatedly "bending" the note. On a trombone, a player may provide a slightly more pronounced vibrato by gently moving the slide back and forth, centering on one note to give a lyrical effect.

Auto-vibrato

Some instruments can only be played with constant, mechanical vibrato (or none at all), notably electric organists using a Leslie speaker. Vibrato on the theremin, which is a continuously variable-pitch instrument with no "stops", can range from delicate to extravagant, and often serves to mask the small pitch adjustments that instrument requires.

Sound examples

- Vibrato, Sound Frequency 500 Hz - Frequency Modulation 50 Hz - Vibrato Frequency 6 Hz
- Tremolo, Sound Frequency 500 Hz - Amplitude Modulation 6 Hz
- Tremolo by beating - Sound Frequencies 500 and 506 Hz, Beat Frequency 6 Hz

References

[1] Sundberg, Johan. "Acoustic and psychoacoustic aspects of vocal vibrato" (http://www.speech.kth.se/prod/publications/files/qpsr/1994/1994_35_2-3_045-068.pdf). . Retrieved 4 October 2010.

[2] Curtin, Joseph (2000-04). "Weinreich and Directional Tone Colour" (http://www.josephcurtinstudios.com/news/strad/apr00/Gabi_strad.htm). *Strad Magazine*. . Retrieved 2009-05-23. "In the case of string instruments, however, not only are they strongly directional, but the pattern of their directionality changes very rapidly with frequency. If you think of that pattern at a given frequency as beacons of sound, like the quills of a porcupine, then even the slight changes in pitch created by vibrato can cause those quills to be continually undulating."

[3] Schleske, Martin. "The psychoacoustic secret of vibrato" (http://www.schleske.de/en/our-research/handbook-violinacoustics/vibrato-of-the-musician.html). . Retrieved 11 February 2010. "The “fiery tone” that likely results from this phenomenon is an essential characteristic of good violins."

[4] http://www.koelnklavier.de/quellen/moz-le/kap11-1.html

[5] Fischer, Simon: *Basics* ISBN 978-190150700, page 221.

[6] Eberhardt, S.: *Violin Vibrato: Its Mastery and Artistic Uses*, pages 12 and 21. Carl Fischer, Inc.

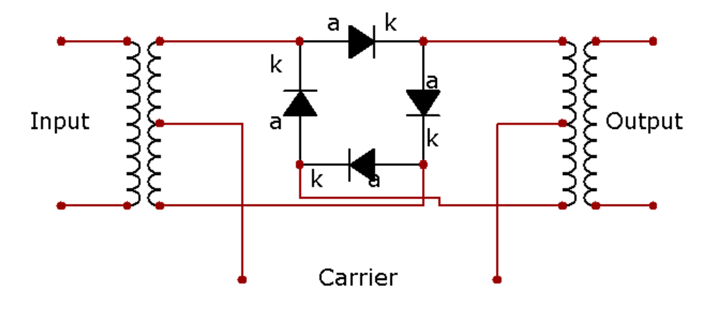
[7] Alexanian, D.: "Traité théorique et pratique du Violoncelle", pages 96 and 97. Dover.

[8] http://www.wellesley.edu/Physics/brown/pubs/vibPerF100P1728-P1735.pdf

External links

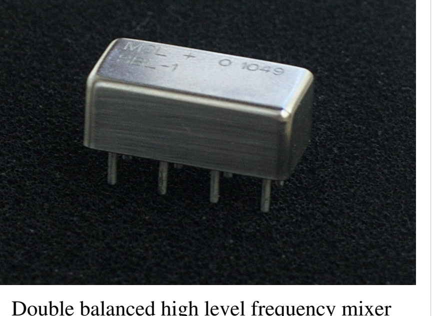
- Vibrato or tremolo? (http://www.vibroworld.com/magnatone/vibrato.html) - technical treatment, but accessible to laypersons
- The Vibrato Page (http://www.standingstones.com/vibrtopg.html) - collection of opinions and quotes against vibrato.
- Roger Norrington writing on vibrato (http://books.guardian.co.uk/review/story/0,12084,904398,00.html) - from a conductor's perspective
- David Montgomery: The Vibrato Thing (http://www.soundpostonline.com/archive/fall2003/page4.htm) - from a musician's perspective, debunking Norrington and Moens-Haenen
- Punctuating your Lead Guitar with String Vibratos (http://www.fretjam.com/string-vibrato.html)
- Use of Vibrato in Baroque Vocal Music (http://ladyviola1593.tripod.com/musichistory) - Historical documentation, brief but clear scientific explanation, and a short bibliography
- David Hurwitz: Vibrato in the Classical Orchestra (http://www.classicstoday.com/features/vibratothree.asp) - latest of three-part essay refuting Norrington and his school; covers the Classical Period
- A riddle over vibrato of clarinet (http://www.geocities.jp/imyfujita/mozart-clarinet-quintet/mozartclarinetquintet.html)

Ring modulation



Schematic diagram of a ring modulator, showing ring of diodes

Ring modulation is a signal-processing effect in electronics, an implementation of amplitude modulation or frequency mixing, performed by multiplying two signals, where one is typically a sine-wave or another simple waveform. It is referred to as "ring" modulation because the analog circuit of diodes originally used to implement this technique took the shape of a ring.[1] This circuit is similar to a bridge rectifier, except that instead of the diodes facing "left" or "right", they go "clockwise" or "anti-clockwise". A **ring modulator** is an effects unit dedicated to producing this sound.


Double balanced high level frequency mixer Mini-Circuits SBL-1 with four Schottky diodes. LO level +7 dBm (1,41 V_{p-p}) and RF 1-500 Mhz.

The carrier, which is AC, at a given time, makes one pair of diodes conduct, and reverse-biases the other pair. The conducting pair carry the signal from the left transformer secondary to the primary of the transformer at the right. If the left carrier terminal is positive, the top and bottom diodes conduct. If that terminal is negative, then the "side" diodes conduct, but create a polarity inversion between the transformers. This action is much like that of a DPDT switch wired for reversing connections.

Examples

These are some audio samples of the ring modulation effect:

Operation

Ring modulators frequency mix or heterodyne two waveforms, and output the sum and difference of the frequencies present in each waveform. This process of ring modulation produces a signal rich in partials, suitable for producing bell-like or otherwise metallic sounds. As well, neither the carrier nor the incoming signal are prominent in the outputs, and ideally, not at all.

Two oscillators, whose frequencies were harmonically related and ring modulated against each other, produce sounds that still adhere to the harmonic partials of the notes, but contain a very different spectral make up.

If the same signal is sent to both inputs of a ring modulator, the resultant harmonic spectrum is the original frequency domain doubled (if $f_1 = f_2 = f$, then $f_2 - f_1 = 0$ and $f_2 + f_1 = 2f$). Regarded as multiplication, this operation amounts to squaring. However, some distortion occurs due to the forward voltage drop of the diodes.

Some modern ring modulators are implemented using digital signal processing techniques by simply multiplying the time domain signals, producing a nearly-perfect signal output. Before digital music synthesizers became common, at least some analog synthesizers (such as the ARP 2600) used analog multipliers for this purpose; they were closely related to those used in electronic analog computers. (The "ring modulator" in the ARP 2600 could multiply control voltages; it could work at DC.)

Multiplication in the time domain is the same as convolution in the frequency domain, so the output waveform contains the sum and difference of the input frequencies. Thus, in the basic case where two sine waves of frequencies f_1 and f_2 ($f_1 < f_2$) are multiplied, two new sine waves are created, with one at $f_1 + f_2$ and the other at $f_2 - f_1$. The two new waves are unlikely to be harmonically related and (in a well designed ring modulator) the original signals are not present. It is this that gives the ring modulator its unique tones.

Intermodulation products can be generated by carefully selecting and changing the frequency of the two input waveforms. If the signals are processed digitally, the frequency-domain convolution becomes circular convolution. If the signals are wideband, this will cause aliasing distortion, so it is common to oversample the operation or low-pass filter the signals prior to ring modulation.

One application is spectral inversion, typically of speech; a carrier frequency is chosen to be above the highest speech frequencies (which are low-pass filtered at, say, 3 kHz, for a carrier of perhaps 3.3 kHz), and the sum frequencies from the modulator are removed by more low-pass filtering. The remaining difference frequencies have an inverted spectrum—High frequencies become low, and vice versa.

Integrated circuit methods of ring modulation

On the C64 SID chip, ring modulation multiplies a triangle wave with a square wave.

On an ARP Odyssey synthesizer (and a few others from that era as well) the ring modulator is an XOR function (formed from two NAND gates) fed from the square wave outputs of the two oscillators. For the limited case of square or pulse wave signals, this is identical to true ring modulation.

Analog multiplier ICs (such as those made by Analog Devices) would work quite nicely as ring modulators, of course with regard to such matters as their operating limits and scale factors. Use of multplier ICs means that the modulation products are largely confined to sum and difference frequency of inputs (unless the circuit is overdriven), rather than the much more complicated products of the rectifier circuit.

Use in music

One of the first products dedicated for music was the *Bode Ring Modulator* developed in 1961 by Harald Bode. In 1964 he developed the *Bode Frequency Shifter,* which produced a clearer sound by eliminating a side band.[2] These devices were designed to be controlled by voltage, for today's modern modular synthesizer architecture, which was also advocated by him,[3] and licensed to R.A. Moog for their Moog modular synthesizers started in 1963-1964.[4] In 1963, Don Buchla included an optional ring modulator in his first modular synthesizer, the Model 100.[5] Also Tom Oberheim built a ring modulator unit for musician friend in the late 1960s,[6] [7] and it became an origin of *Maestro Ring Modulator*,[8] one of the earliest ring modulator effect products for guitarists.

Early electronic composers, particularly Stockhausen, used ring-modulator effects. Stockhausen used ring modulation as early as 1956 for some sounds in *Gesang der Jünglinge* and his realization score for *Telemusik* (1966) also calls for it. Indeed, whole compositions are based around it, such as *Mixtur* (1964), one of the first compositions for orchestra and live electronics, *Mikrophonie II* (1965, where the sounds of choral voices are modulated with a Hammond organ), *Mantra* (1970, where the sounds from two pianos are routed through ring modulators), and *Licht-Bilder* (2002) from *Sonntag aus Licht*, which ring-modulates flute and trumpet.[9] [10] [11]

One of the best-known applications of the ring modulator may be its use by Brian Hodgson of the BBC Radiophonic Workshop to produce the distinctive voice of the Daleks in the television series *Doctor Who*, starting in 1963.[12]

Other applications

Ring modulation has also been extensively used in radio receivers, for example to demodulate an FM stereo signal and to down-convert microwave signals in mobile telephone and wireless networking systems.

References

[1] Richard Orton, "Ring Modulator", *The New Grove Dictionary of Music and Musicians*, second edition, edited by Stanley Sadie and John Tyrrell (London: Macmillan Publications; New York: Grove's Dictionaries of Music, 2001): "the ring modulator takes its name from the characteristic ring formation of four diodes in its analog circuit."
[2] "Harald Bode - A Lifetime for Sound" (http://rebekkahpalov.i8.com/HBodeProgram.pdf). Harald Bode News. . Retrieved 2011-01-27.
[3] H. Bode. "European electronic Music Instrument Design". *journal of the Audio Engineering Society* **ix** (1961): 267.
[4] Tom Rhea (2004). "Harald Bode biography" (http://www.experimentaltvcenter.org/history/people/bio.php3?id=83). New York: Experimental Television Center Ltd. .
[5] "Buchla Electronic Musical Instruments - Historical Overview" (http://www.buchla.com/historical/). . Retrieved 2011-01-27.
[6] Thomas E. Oberheim (May 1970). "A Ring Modulator Device for the Performing Musician". *AES Convention 38*: 708.
[7] "Session Transcript: Tom Oberheim" (http://www.redbullmusicacademy.com/video-archive/transcript/tom_oberheim_polyphonic_one_love/transcript). *Red Bull Music Academy Barcelona 2008*. .
[8] "Marstro RM-1A Ring Modulator" (http://www.effectsdatabase.com/model/maestro/rm1/a). DiscoFreq's Effects Database. .
[9] Ludger Brümmer, "Stockhausen on Electronics, 2004", *Computer Music Journal* 32, no. 4 (2008):10–16.
[10] Karlheinz Stockhausen, "Electroacoustic Performance Practice", translated by Jerome Kohl, *Perspectives of New Music* 34, no. 1 (Winter, 1996): 74-105. Citation on 89.
[11] Karlheinz Stockhausen, "Einführung"/"Introduction", English translation by Suzanne Stephens, in booklet accompanying Karlheinz Stockhausen, *Licht-Bilder (3. Szene vom SONNTAG aus LICHT)*, 2-CD set, Stockhausen Gesamtausgabe/Complete Edition 68A–B (Kürten: Stockhausen-Verlag, 2005): 10 & 51
[12] Jeremy Bentham, *Doctor Who: The Early Years* (London: W.H. Allen, 1986): 127. ISBN 0-491-03612-4.

External links

- Scott Lehman. "Effects Explained: Ring Modulation" (http://replay.waybackmachine.org/20051201090154/http://www.harmony-central.com/Effects/Articles/Ring_Modulation/). Harmony Central. Archived from the original (http://www.harmony-central.com/Effects/Articles/Ring_Modulation/) on 2005-12-01.

Chorus effect

A **chorus effect** occurs when individual sounds with roughly the same timbre and nearly (but never exactly) the same pitch converge and are perceived as one. While similar sounds coming from multiple sources can occur naturally (as in the case of a choir or string orchestra), it can also be simulated using an electronic effects unit or signal processing device.

Methods

When the effect is produced successfully, none of the constituent sounds is perceived as being out of tune. Rather, this amalgam of sounds has a rich, shimmering quality which would be absent if the sound came from a single source. The effect is more apparent when listening to sounds that sustain for longer periods of time.

The chorus effect is especially easy to hear when listening to a choir or string ensemble. A choir has multiple people singing each part (soprano, tenor, etc.). A string ensemble has multiple violinists and possibly multiples of other stringed instruments. When individual singers or violins play the same part, the chorus effect can be heard. Some instruments produce the effect all on their own. Examples include:

- Piano - Each hammer strikes multiple strings tuned to nearly the same pitch (for all notes except the bass notes). The chorus effect is so intrinsic to the timbre of a piano that it is difficult to recognize.
- 12 string guitar - Six pairs of strings tuned in octaves and unisons create a chorus effect.
- Synthesizer. The effect is achieved by assigning multiple, slightly detuned oscillators to a voice. This is referred to as "Unison" by some manufacturers.
- Mandolin - 4 pairs of identically tuned strings, as opposed to octaves and unisons on the 12-string guitar.

Electronic effect

SmallClone chorus unit

The chorus effect can be simulated by signal processing equipment. The signal processor may be software running on a computer, a ROM-encoded effect in a digital effect processor, or an analog effect processor. If the processor is hardware-based, it may be packaged as a foot pedal, a rack-mount module, a table-top device, or built in to an instrument amplifier (often an acoustic guitar amplifier or an electric guitar amplifier). Some keyboard instruments have an electronic chorus effect built in, such as some electronic pianos and some Hammond organs.

Regardless of the technology or form factor, the processor achieves the effect by taking an audio signal and mixing it with one or more delayed, pitch-modulated copies of itself. The pitch of the added voices is typically modulated by an LFO, which makes the overall effect similar to that of a flanger, except with longer delays and without feedback.

Stereo chorus effect processors produce the same effect, but it is varied between the left and right channels by offsetting the delay or phase of the LFO. The effect is thereby enhanced because sounds are produced from multiple locations in the stereo field. Used on instruments like "clean" (undistorted) electric guitar and keyboards, it can yield very dreamy or ambient sounds. Commercial chorus effect devices often include controls that enable them to be used to also produce delay, reverberation, or other related effects that use similar hardware, rather than exclusively as chorus effects.

External links

- P.A.S. - Boss Chorus Ensemble [1]
- Electro-Harmonix: Chorus Pedals [2]
- Chorus effect sound samples [3]

References

[1] http://www.pedalarea.com/chorus_ensemble.htm
[2] http://www.ehx.com/browse/chorus-phase-shifters-flangers
[3] http://www.noiseon.com/Results.aspx?catid=9

Low-pass filter

A **low-pass filter** is a filter that passes low-frequency signals but attenuates (reduces the amplitude of) signals with frequencies higher than the cutoff frequency. The actual amount of attenuation for each frequency varies from filter to filter. It is sometimes called a **high-cut filter**, or **treble cut filter** when used in audio applications. A low-pass filter is the opposite of a high-pass filter. A band-pass filter is a combination of a low-pass and a high-pass.

Low-pass filters exist in many different forms, including electronic circuits (such as a *hiss filter* used in audio), anti-aliasing filters for conditioning signals prior to analog-to-digital conversion, digital filters for smoothing sets of data, acoustic barriers, blurring of images, and so on. The moving average operation used in fields such as finance is a particular kind of low-pass filter, and can be analyzed with the same signal processing techniques as are used for other low-pass filters. Low-pass filters provide a smoother form of a signal, removing the short-term fluctuations, and leaving the longer-term trend.

Examples of low-pass filters

Acoustic

A stiff physical barrier tends to reflect higher sound frequencies, and so acts as a low-pass filter for transmitting sound. When music is playing in another room, the low notes are easily heard, while the high notes are attenuated.

Electronic

In an electronic low-pass RC filter for voltage signals, high frequencies contained in the input signal are attenuated but the filter has little attenuation below its cutoff frequency which is determined by its RC time constant.

For current signals, a similar circuit using a resistor and capacitor in parallel works in a similar manner. See current divider discussed in more detail below.

Electronic low-pass filters are used to drive subwoofers and other types of loudspeakers, to block high pitches that they can't efficiently broadcast.

Radio transmitters use low-pass filters to block harmonic emissions which might cause interference with other communications.

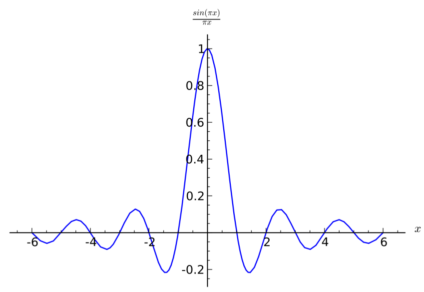
The tone knob found on many electric guitars is a low-pass filter used to reduce the amount of treble in the sound.

An integrator is another example of a single time constant low-pass filter.[1]

Telephone lines fitted with DSL splitters use low-pass and high-pass filters to separate DSL and POTS signals sharing the same pair of wires.

Low-pass filters also play a significant role in the sculpting of sound for electronic music as created by analogue synthesisers. *See subtractive synthesis.*

Ideal and real filters


The sinc function, the impulse response of an ideal low-pass filter.

An ideal low-pass filter completely eliminates all frequencies above the cutoff frequency while passing those below unchanged: its frequency response is a rectangular function, and is a brick-wall filter. The transition region present in practical filters does not exist in an ideal filter. An ideal low-pass filter can be realized mathematically (theoretically) by multiplying a signal by the rectangular function in the frequency domain or, equivalently, convolution with its impulse response, a sinc function, in the time domain.

However, the ideal filter is impossible to realize without also having signals of infinite extent in time, and so generally needs to be approximated for real ongoing signals, because the sinc function's support region extends to all past and future times. The filter would therefore need to have infinite delay, or knowledge of the infinite future and past, in order to perform the convolution. It is effectively realizable for pre-recorded digital signals by assuming extensions of zero into the past and future, or more typically by making the signal repetitive and using Fourier analysis.

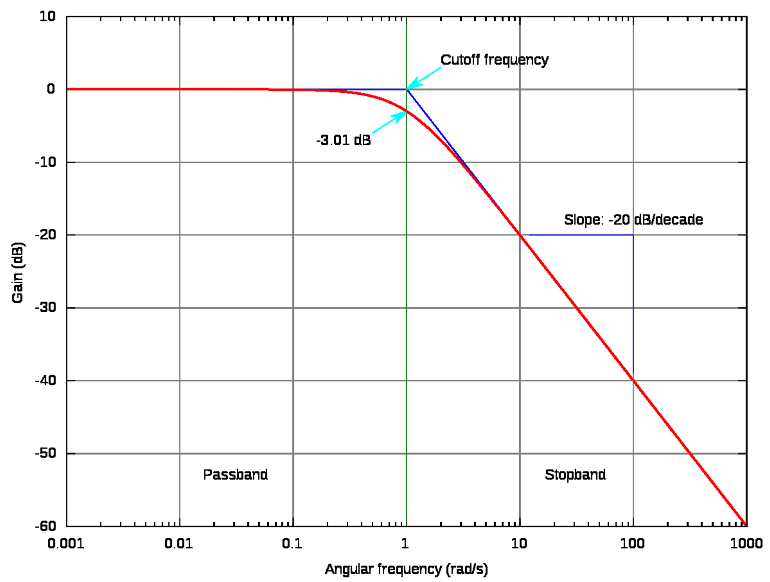
Real filters for real-time applications approximate the ideal filter by truncating and windowing the infinite impulse response to make a finite impulse response; applying that filter requires delaying the signal for a moderate period of time, allowing the computation to "see" a little bit into the future. This delay is manifested as phase shift. Greater accuracy in approximation requires a longer delay.

An ideal low-pass filter results in ringing artifacts via the Gibbs phenomenon. These can be reduced or worsened by choice of windowing function, and the design and choice of real filters involves understanding and minimizing these artifacts. For example, "simple truncation [of sinc] causes severe ringing artifacts," in signal reconstruction, and to reduce these artifacts one uses window functions "which drop off more smoothly at the edges."[2]

The Whittaker–Shannon interpolation formula describes how to use a perfect low-pass filter to reconstruct a continuous signal from a sampled digital signal. Real digital-to-analog converters use real filter approximations.

Continuous-time low-pass filters

There are many different types of filter circuits, with different responses to changing frequency. The frequency response of a filter is generally represented using a Bode plot, and the filter is characterized by its cutoff frequency and rate of frequency rolloff. In all cases, at the *cutoff frequency,* the filter attenuates the input power by half or 3 dB. So the **order** of the filter determines the amount of additional attenuation for frequencies higher than the cutoff frequency.



The gain-magnitude frequency response of a first-order (one-pole) low-pass filter. *Power gain* is shown in decibels (i.e., a 3 dB decline reflects an additional half-power attenuation). Angular frequency is shown on a logarithmic scale in units of radians per second.

- A **first-order filter**, for example, will reduce the signal amplitude by half (so power reduces by a factor of 4), or 6 dB, every time the frequency doubles (goes up one octave); more precisely, the power rolloff approaches 20 dB per decade in the limit of high frequency. The magnitude Bode plot for a first-order filter looks like a horizontal line below the cutoff frequency, and a diagonal line above the cutoff frequency. There is also a "knee curve" at the boundary between the two, which smoothly transitions between the two straight line regions. If the transfer function of a first-order low-pass filter has a zero as well as a pole, the Bode plot will flatten out again, at some maximum attenuation of high frequencies; such an effect is caused for example by a little bit of the input leaking around the one-pole filter; this one-pole–one-zero filter is still a first-order low-pass. *See Pole–zero plot and RC circuit.*
- A **second-order filter** attenuates higher frequencies more steeply. The Bode plot for this type of filter resembles that of a first-order filter, except that it falls off more quickly. For example, a second-order Butterworth filter will reduce the signal amplitude to one fourth its original level every time the frequency doubles (so power decreases by 12 dB per octave, or 40 dB per decade). Other all-pole second-order filters may roll off at different rates initially depending on their Q factor, but approach the same final rate of 12 dB per octave; as with the first-order filters, zeroes in the transfer function can change the high-frequency asymptote. See RLC circuit.
- Third- and higher-order filters are defined similarly. In general, the final rate of power rolloff for an order- n all-pole filter is $6n$ dB per octave (i.e., $20n$ dB per decade).

On any Butterworth filter, if one extends the horizontal line to the right and the diagonal line to the upper-left (the asymptotes of the function), they will intersect at exactly the "cutoff frequency". The frequency response at the cutoff frequency in a first-order filter is 3 dB below the horizontal line. The various types of filters — Butterworth filter, Chebyshev filter, Bessel filter, etc. — all have different-looking "knee curves". Many second-order filters are designed to have "peaking" or resonance, causing their frequency response at the cutoff frequency to be *above* the horizontal line. *See electronic filter for other types.*

The meanings of 'low' and 'high' — that is, the cutoff frequency — depend on the characteristics of the filter. The term "low-pass filter" merely refers to the shape of the filter's response; a high-pass filter could be built that cuts off at a lower frequency than any low-pass filter — it is their responses that set them apart. Electronic circuits can be devised for any desired frequency range, right up through microwave frequencies (above 1 GHz) and higher.

Laplace notation

Continuous-time filters can also be described in terms of the Laplace transform of their impulse response in a way that allows all of the characteristics of the filter to be easily analyzed by considering the pattern of poles and zeros of the Laplace transform in the complex plane (in discrete time, one can similarly consider the Z-transform of the impulse response).

For example, a first-order low-pass filter can be described in Laplace notation as

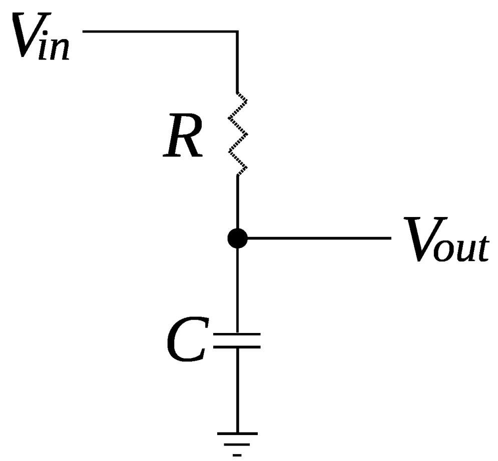
$$\frac{\text{Output}}{\text{Input}} = K\frac{1}{1+s\tau}$$

where s is the Laplace transform variable, τ is the filter time constant, and K is the filter passband gain.

Electronic low-pass filters

Passive electronic realization

One simple electrical circuit that will serve as a low-pass filter consists of a resistor in series with a load, and a capacitor in parallel with the load. The capacitor exhibits reactance, and blocks low-frequency signals, causing them to go through the load instead. At higher frequencies the reactance drops, and the capacitor effectively functions as a short circuit. The combination of resistance and capacitance gives you the time constant of the filter $\tau = RC$ (represented by the Greek letter tau). The break frequency, also called the turnover frequency or cutoff frequency (in hertz), is determined by the time constant:



Passive, first order low-pass RC filter

$$f_\mathrm{c} = \frac{1}{2\pi\tau} = \frac{1}{2\pi RC}$$

or equivalently (in radians per second):

$$\omega_\mathrm{c} = \frac{1}{\tau} = \frac{1}{RC}.$$

One way to understand this circuit is to focus on the time the capacitor takes to charge. It takes time to charge or discharge the capacitor through that resistor:

- At low frequencies, there is plenty of time for the capacitor to charge up to practically the same voltage as the input voltage.
- At high frequencies, the capacitor only has time to charge up a small amount before the input switches direction. The output goes up and down only a small fraction of the amount the input goes up and down. At double the frequency, there's only time for it to charge up half the amount.

Another way to understand this circuit is with the idea of reactance at a particular frequency:

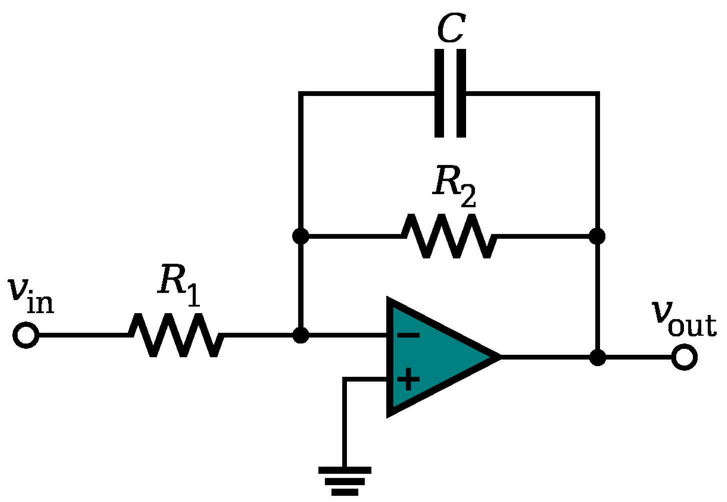
- Since DC cannot flow through the capacitor, DC input must "flow out" the path marked V_out (analogous to removing the capacitor).
- Since AC flows very well through the capacitor — almost as well as it flows through solid wire — AC input "flows out" through the capacitor, effectively short circuiting to ground (analogous to replacing the capacitor with just a wire).

The capacitor is not an "on/off" object (like the block or pass fluidic explanation above). The capacitor will variably act between these two extremes. It is the Bode plot and frequency response that show this variability.

Active electronic realization

Another type of electrical circuit is an *active* low-pass filter.

In the operational amplifier circuit shown in the figure, the cutoff frequency (in hertz) is defined as:



An active low-pass filter

$$f_c = \frac{1}{2\pi R_2 C}$$

or equivalently (in radians per second):

$$\omega_c = \frac{1}{R_2 C}.$$

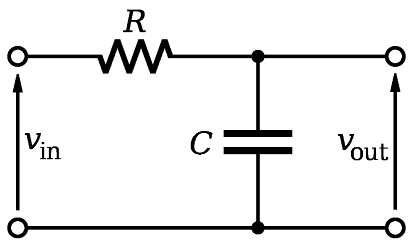
The gain in the passband is $-R_2/R_1$, and the stopband drops off at −6 dB per octave as it is a first-order filter.

Discrete-time realization

The effect of a low-pass filter can be simulated on a computer by analyzing its behavior in the time domain, and then discretizing the model.

From the circuit diagram to the right, according to Kirchoff's Laws and the definition of capacitance:

{{{}}}



A simple low-pass RC filter

$v_{\text{in}}(t) - v_{\text{out}}(t) = R\,i(t)$	**(V)**

{{{}}}

{{{}}}

$Q_c(t) = C\,v_{\text{out}}(t)$	**(Q)**

{{{}}}

{{{}}}

$i(t) = \frac{\mathrm{d}Q_c}{\mathrm{d}t}$,	(I)

{{{}}} where $Q_c(t)$ is the charge stored in the capacitor at time t . Substituting equation **Q** into equation **I** gives $i(t) = C\frac{\mathrm{d}v_{\text{out}}}{\mathrm{d}t}$, which can be substituted into equation **V** so that:

$$v_{\text{in}}(t) - v_{\text{out}}(t) = RC\frac{\mathrm{d}v_{\text{out}}}{\mathrm{d}t}.$$

This equation can be discretized. For simplicity, assume that samples of the input and output are taken at evenly-spaced points in time separated by Δ_T time. Let the samples of v_{in} be represented by the sequence $(x_1, x_2, \ldots, x_n)$, and let v_{out} be represented by the sequence $(y_1, y_2, \ldots, y_n)$ which correspond to the same points in time. Making these substitutions:

$$x_i - y_i = RC\,\frac{y_i - y_{i-1}}{\Delta_T}.$$

And rearranging terms gives the recurrence relation

$$y_i = \overbrace{x_i\left(\frac{\Delta_T}{RC + \Delta_T}\right)}^{\text{Input contribution}} + \overbrace{y_{i-1}\left(\frac{RC}{RC + \Delta_T}\right)}^{\text{Inertia from previous output}}.$$

That is, this discrete-time implementation of a simple RC low-pass filter is the exponentially-weighted moving average

$$y_i = \alpha x_i + (1 - \alpha) y_{i-1} \qquad \text{where} \qquad \alpha \triangleq \frac{\Delta_T}{RC + \Delta_T}.$$

By definition, the *smoothing factor* $0 \leq \alpha \leq 1$. The expression for α yields the equivalent time constant RC in terms of the sampling period Δ_T and smoothing factor α :

$$RC = \Delta_T \left(\frac{1 - \alpha}{\alpha}\right).$$

If $\alpha = 0.5$, then the RC time constant is equal to the sampling period. If $\alpha \ll 0.5$, then RC is significantly larger than the sampling interval, and $\Delta_T \approx \alpha RC$.

Algorithmic implementation

The filter recurrence relation provides a way to determine the output samples in terms of the input samples and the preceding output. The following pseudocode algorithm will simulate the effect of a low-pass filter on a series of digital samples:

```
// Return RC low-pass filter output samples, given input samples,
// time interval dt, and time constant RC
function lowpass(real[0..n] x, real dt, real RC)
  var real[0..n] y
  var real α := dt / (RC + dt)
  y[0] := x[0]
  for i from 1 to n
      y[i] := α * x[i] + (1-α) * y[i-1]
  return y
```

The loop which calculates each of the n outputs can be refactored into the equivalent:

```
for i from 1 to n
    y[i] := y[i-1] + α * (x[i] - y[i-1])
```

That is, the change from one filter output to the next is proportional to the difference between the previous output and the next input. This exponential smoothing property matches the exponential decay seen in the continuous-time system. As expected, as the time constant RC increases, the discrete-time smoothing parameter α decreases, and the output samples $(y_1, y_2, \ldots, y_n)$ respond more slowly to a change in the input samples $(x_1, x_2, \ldots, x_n)$ – the system will have more *inertia*.

References

[1] Sedra, Adel (1991). *Microelectronic Circuits, 3 ed.*. Saunders College Publishing. p. 60. ISBN 0-03-051648-X.
[2] Mastering Windows: Improving Reconstruction (http://www.cg.tuwien.ac.at/research/vis/vismed/Windows/MasteringWindows.pdf)

External links

- Low-pass filter (http://www.allaboutcircuits.com/vol_2/chpt_8/2.html)
- Low Pass Filter java simulator (http://www.st-andrews.ac.uk/~www_pa/Scots_Guide/experiment/lowpass/lpf.html)
- ECE 209: Review of Circuits as LTI Systems (http://www.tedpavlic.com/teaching/osu/ece209/support/circuits_sys_review.pdf) – Short primer on the mathematical analysis of (electrical) LTI systems.
- ECE 209: Sources of Phase Shift (http://www.tedpavlic.com/teaching/osu/ece209/lab3_opamp_FO/lab3_opamp_FO_phase_shift.pdf) – Gives an intuitive explanation of the source of phase shift in a low-pass filter. Also verifies simple passive LPF transfer function by means of trigonometric identity.

High-pass filter

A **high-pass filter**, or HPF, is an LTI filter that passes high frequencies well but attenuates (i.e., reduces the amplitude of) frequencies lower than the filter's cutoff frequency. The actual amount of attenuation for each frequency is a design parameter of the filter. It is sometimes called a **low-cut filter** or **bass-cut filter**.[1]

High-pass filters have many uses, such as blocking DC from circuitry sensitive to non-zero average voltages or RF devices. They can also be used in conjunction with a low-pass filter to make a bandpass filter.

First-order continuous-time implementation

The simple first-order electronic high-pass filter shown in Figure 1 is implemented by placing an input voltage across the series combination of a capacitor and a resistor and using the voltage across the resistor as an output. The product of the resistance and capacitance (*R*×*C*) is the time constant (τ); it is inversely proportional to the cutoff frequency f_c, at which the output power is half the input power. That is,

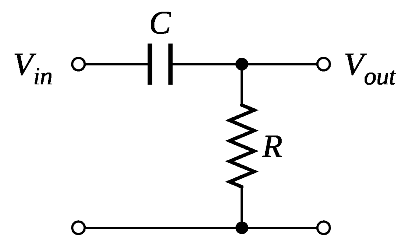


Figure 1: A passive, analog, first-order high-pass filter, realized by an RC circuit

$$f_c = \frac{1}{2\pi\tau} = \frac{1}{2\pi RC},$$

where f_c is in hertz, τ is in seconds, R is in ohms, and C is in farads.

Figure 2 shows an active electronic implementation of a first-order high-pass filter using an operational amplifier. In this case, the filter has a passband gain of $-R_2/R_1$ and has a corner frequency of

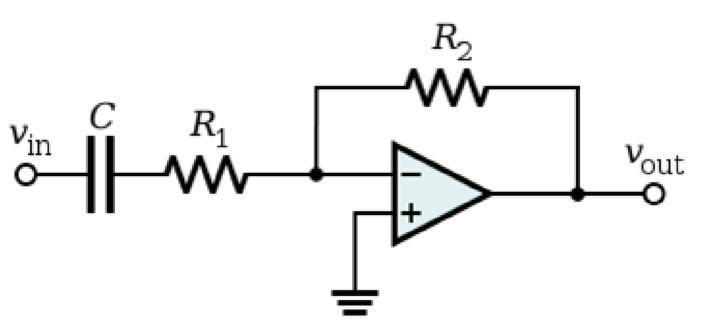


Figure 2: An active high-pass filter

$$f_c = \frac{1}{2\pi\tau} = \frac{1}{2\pi R_1 C},$$

Because this filter is active, it may have non-unity passband gain. That is, high-frequency signals are inverted and amplified by R_2/R_1.

Discrete-time realization

Discrete-time high-pass filters can also be designed. Discrete-time filter design is beyond the scope of this article; however, a simple example comes from the conversion of the continuous-time high-pass filter above to a discrete-time realization. That is, the continuous-time behavior can be discretized.

From the circuit in Figure 1 above, according to Kirchoff's Laws and the definition of capacitance:

$$\begin{cases} V_{\text{out}}(t) = I(t)\, R & \text{(V)} \\ Q_c(t) = C\,\left(V_{\text{in}}(t) - V_{\text{out}}(t)\right) & \text{(Q)} \\ I(t) = \frac{\mathrm{d}Q_c}{\mathrm{d}t} & \text{(I)} \end{cases}$$

where $Q_c(t)$ is the charge stored in the capacitor at time t. Substituting Equation (Q) into Equation (I) and then Equation (I) into Equation (V) gives:

$$V_{\text{out}}(t) = \overbrace{C\left(\frac{\mathrm{d}V_{\text{in}}}{\mathrm{d}t} - \frac{\mathrm{d}V_{\text{out}}}{\mathrm{d}t}\right)}^{I(t)} R = RC\left(\frac{\mathrm{d}V_{\text{in}}}{\mathrm{d}t} - \frac{\mathrm{d}V_{\text{out}}}{\mathrm{d}t}\right)$$

This equation can be discretized. For simplicity, assume that samples of the input and output are taken at evenly-spaced points in time separated by Δ_T time. Let the samples of V_{in} be represented by the sequence $(x_1, x_2, \ldots, x_n)$, and let V_{out} be represented by the sequence $(y_1, y_2, \ldots, y_n)$ which correspond to the same points in time. Making these substitutions:

$$y_i = RC\left(\frac{x_i - x_{i-1}}{\Delta_T} - \frac{y_i - y_{i-1}}{\Delta_T}\right)$$

And rearranging terms gives the recurrence relation

$$y_i = \overbrace{\frac{RC}{RC + \Delta_T} y_{i-1}}^{\text{Decaying contribution from prior inputs}} + \overbrace{\frac{RC}{RC + \Delta_T}\left(x_i - x_{i-1}\right)}^{\text{Contribution from change in input}}$$

That is, this discrete-time implementation of a simple continuous-time RC high-pass filter is

$$y_i = \alpha y_{i-1} + \alpha(x_i - x_{i-1}) \qquad \text{where} \qquad \alpha \triangleq \frac{RC}{RC + \Delta_T}$$

By definition, $0 \leq \alpha \leq 1$. The expression for parameter α yields the equivalent time constant RC in terms of the sampling period Δ_T and α:

$$RC = \Delta_T \left(\frac{\alpha}{1 - \alpha} \right)$$

If $\alpha = 0.5$, then the RC time constant equal to the sampling period. If $\alpha \ll 0.5$, then RC is significantly smaller than the sampling interval, and $RC \approx \alpha \Delta_T$.

Algorithmic implementation

The filter recurrence relation provides a way to determine the output samples in terms of the input samples and the preceding output. The following pseudocode algorithm will simulate the effect of a high-pass filter on a series of digital samples:

```
// Return RC high-pass filter output samples, given input samples,
// time interval dt, and time constant RC
function highpass(real[0..n] x, real dt, real RC)
  var real[0..n] y
  var real α := RC / (RC + dt)
  y[0] := 0
  for i from 1 to n
    y[i] := α * y[i-1] + α * (x[i] - x[i-1])
  return y
```

The loop which calculates each of the n outputs can be refactored into the equivalent:

```
  for i from 1 to n
    y[i] := α * (y[i-1] + x[i] - x[i-1])
```

However, the earlier form shows how the parameter α changes the impact of the prior output `y[i-1]` and current *change* in input `(x[i] - x[i-1])`. In particular,

- A large α implies that the output will decay very slowly but will also be strongly influenced by even small changes in input. By the relationship between parameter α and time constant RC above, a large α corresponds to a large RC and therefore a low corner frequency of the filter. Hence, this case corresponds to a high-pass filter with a very narrow stop band. Because it is excited by small changes and tends to hold its prior output values for a long time, it can pass relatively low frequencies. However, a constant input (i.e., an input with `(x[i] - x[i-1])=0`) will always decay to zero, as would be expected with a high-pass filter with a large RC.
- A small α implies that the output will decay quickly and will require large changes in the input (i.e., `(x[i] - x[i-1])` is large) to cause the output to change much. By the relationship between parameter α and time constant RC above, a small α corresponds to a small RC and therefore a high corner frequency of the filter. Hence, this case corresponds to a high-pass filter with a very wide stop band. Because it requires large (i.e., fast) changes and tends to quickly forget its prior output values, it can only pass relatively high frequencies, as would be expected with a high-pass filter with a small RC.

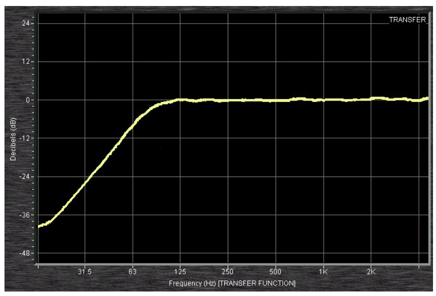
Applications

Audio

High-pass filters have many applications. They are used as part of an audio crossover to direct high frequencies to a tweeter while attenuating bass signals which could interfere with, or damage, the speaker. When such a filter is built into a loudspeaker cabinet it is normally a passive filter that also includes a low-pass filter for the woofer and so often employs both a capacitor and inductor (although very simple high-pass filters for tweeters can consist of a series capacitor and nothing else). An alternative, which provides good quality sound without inductors (which are prone to parasitic coupling, are expensive, and may have significant internal resistance) is to employ bi-amplification with active RC filters or active digital filters with separate power amplifiers for each loudspeaker. Such low-current and low-voltage line level crossovers are called active crossovers.[1]

Rumble filters are high-pass filters applied to the removal of unwanted sounds near to the lower end of the audible range or below. For example, noises (e.g., footsteps, or motor noises from record players and tape decks) may be removed because they are undesired or may overload the RIAA equalization circuit of the preamp.[1]

High-pass filters are also used for AC coupling at the inputs of many audio amplifiers, for preventing the amplification of DC currents which may harm the amplifier, rob the amplifier of headroom, and generate waste heat at the loudspeakers voice coil. One amplifier, the professional audio model DC300 made by Crown International beginning in the 1960s, did not have high-pass filtering at all, and could be used to amplify the DC signal of a common 9-volt battery at the input to supply 18 volts DC in an emergency for mixing console power.[2] However, that model's basic design has been superseded by newer designs such as the Crown Macro-Tech series developed in the late 1980s which included 10 Hz high-pass filtering on the inputs and switchable 35 Hz high-pass filtering on the outputs.[3] Another example is the QSC Audio PLX amplifier series which includes an internal 5 Hz high-pass filter which is applied to the inputs whenever the optional 50 and 30 Hz high-pass filters are turned off.[4]



A 75 Hz "low cut" filter from an input channel of a Mackie 1402 mixing console as measured by Smaart software. This high-pass filter has a slope of 18 dB per octave.

Mixing consoles often include high-pass filtering at each channel strip. Some models have fixed-slope, fixed-frequency high-pass filters at 80 or 100 Hz that can be engaged; other models have 'sweepable HPF'—a high-pass filter of fixed slope that can be set within a specified frequency range, such as from 20 to 400 Hz on the Midas Heritage 3000, or 20 to 20,000 Hz on the Yamaha M7CL digital mixing console. Veteran systems engineer and live sound mixer Bruce Main recommends that high-pass filters be engaged for most mixer input sources, except for those such as kick drum, bass guitar and piano, sources which will have useful low frequency sounds. Main writes that DI unit inputs (as opposed to microphone inputs) do not need high-pass filtering as they are not subject to modulation by low-frequency stage wash—low frequency sounds coming from the subwoofers or the public address system and wrapping around to the stage. Main indicates that high-pass filters are commonly used for directional microphones which have a proximity effect—a low-frequency boost for very close sources. This low frequency boost commonly causes problems up to 200 or 300 Hz, but Main notes that he has seen microphones that benefit from a 500 Hz HPF setting on the console.[5]

Image

High-pass and low-pass filters are also used in digital image processing to perform image modifications, enhancements, noise reduction, etc., using designs done in either the spatial domain or the frequency domain.[6] The unsharp masking, or sharpening, operation used in image editing software is a high-boost filter, a generalization of high-pass.

References

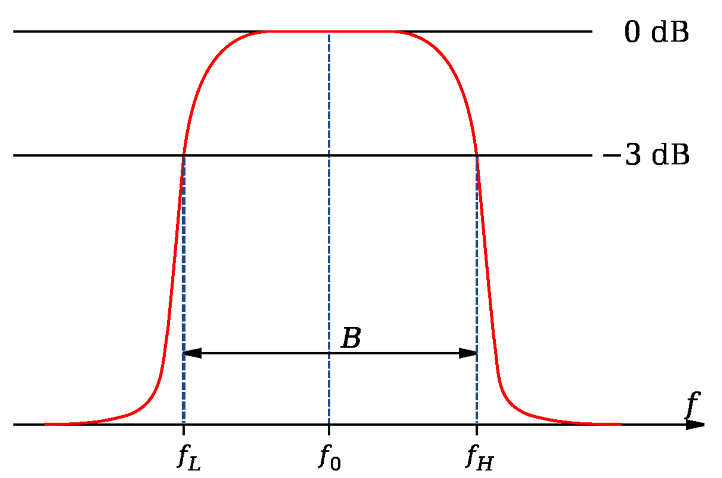
[1] Watkinson, John (1998). *The Art of Sound Reproduction* (http://books.google.com/books?id=01u_Vm5i5isC&pg=PA479). Focal Press. pp. 268, 479. ISBN 0240515129. . Retrieved March 9, 2010.
[2] Andrews, Keith; posting as ssltech (January 11, 2010). "Re: Running the board for a show this big?" (http://recforums.prosoundweb.com/index.php/m/462291/0/). *Recording, Engineering & Production*. ProSoundWeb. . Retrieved 9 March 2010.
[3] "Operation Manual: MA-5002VZ" (http://www.crownaudio.com/pdf/amps/128313.pdf). *Macro-Tech Series*. Crown Audio. 2007. . Retrieved March 9, 2010.
[4] "User Manual: PLX Series Amplifiers" (http://media.qscaudio.com/pdfs/plxuser.pdf). QSC Audio. 1999. . Retrieved March 9, 2010.
[5] Main, Bruce (February 16, 2010). "Cut 'Em Off At The Pass: Effective Uses Of High-Pass Filtering". *Live Sound International* (Framingham, Massachusetts: ProSoundWeb, EH Publishing).
[6] Paul M. Mather (2004). *Computer processing of remotely sensed images: an introduction* (http://books.google.com/books?id=Idj8Eg-KtMAC&pg=PA181&dq=image+high-pass+low-pass+frequency-domain&hl=en&ei=S3XxTNm2BtK1ngemtKn1Cg&sa=X&oi=book_result&ct=result&resnum=6&ved=0CE8Q6AEwBQ#v=onepage&q=image high-pass low-pass frequency-domain&f=false) (3rd ed.). John Wiley and Sons. p. 181. ISBN 9780470849194. .

External links

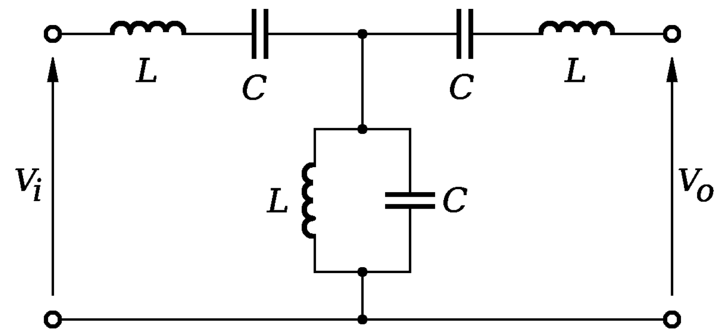
- Common Impulse Responses (http://www.dspguide.com/ch7/1.htm)
- ECE 209: Review of Circuits as LTI Systems (http://www.tedpavlic.com/teaching/osu/ece209/support/circuits_sys_review.pdf) – Short primer on the mathematical analysis of (electrical) LTI systems.
- ECE 209: Sources of Phase Shift (http://www.tedpavlic.com/teaching/osu/ece209/lab3_opamp_FO/lab3_opamp_FO_phase_shift.pdf) – Gives an intuitive explanation of the source of phase shift in a high-pass filter. Also verifies simple passive LPF transfer function by means of trigonometric identity.

Band-pass filter

A **band-pass filter** is a device that passes frequencies within a certain range and rejects (attenuates) frequencies outside that range. An example of an analogue electronic band-pass filter is an RLC circuit (a resistor–inductor–capacitor circuit). These filters can also be created by combining a low-pass filter with a high-pass filter.[1]



Bandwidth measured at half-power points (gain -3 dB, √2/2, or about 0.707 relative to peak) on a diagram showing magnitude transfer function versus frequency for a band-pass filter



A medium-complexity example of a band-Pass filter

Bandpass is an adjective that describes a type of filter or filtering process; it is frequently confused with passband, which refers to the actual portion of affected spectrum. The two words are both compound words that follow the English rules of formation: the primary meaning is the latter part of the compound, while the modifier is the first part. Hence, one may correctly say 'A dual bandpass filter has two passbands'. A *bandpass signal* is a signal containing a band of frequencies away from zero frequency, such as a signal that comes out of a bandpass filter.[2]

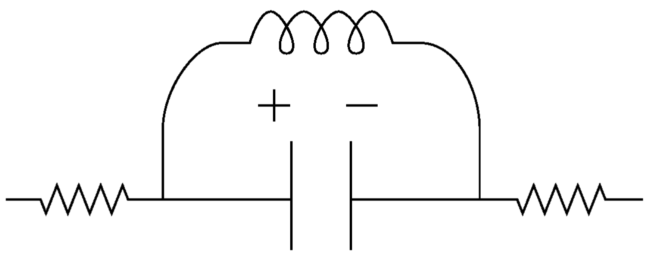
An ideal bandpass filter would have a completely flat passband (e.g. with no gain/attenuation throughout) and would completely attenuate all frequencies outside the passband. Additionally, the transition out of the passband would be instantaneous in frequency. In practice, no bandpass filter is ideal. The filter does not attenuate all frequencies outside the desired frequency range completely; in particular, there is a region just outside the intended passband where frequencies are attenuated, but not rejected. This is known as the filter roll-off, and it is usually expressed in dB of attenuation per octave or decade of frequency. Generally, the design of a filter seeks to make the roll-off as narrow as possible, thus allowing the filter to perform as close as possible to its intended design. Often, this is achieved at the expense of pass-band or stop-band *ripple*.

The bandwidth of the filter is simply the difference between the upper and lower cutoff frequencies. The shape factor is the ratio of bandwidths measured using two different attenuation values to determine the cutoff frequency, e.g., a shape factor of 2:1 at 30/3 dB means the bandwidth measured between frequencies at 30 dB attenuation is twice that measured between frequencies at 3 dB attenuation.

Outside of electronics and signal processing, one example of the use of band-pass filters is in the atmospheric sciences. It is common to band-pass filter recent meteorological data with a period range of, for example, 3 to 10 days, so that only cyclones remain as fluctuations in the data fields.

In neuroscience, visual cortical simple cells were first shown by David Hubel and Torsten Wiesel to have response properties that resemble Gabor filters, which are band-pass.[3]

References in popular culture



The schematic showing "Kilroy", which Pynchon said represents part of a band-pass filter.

In his first novel, *V.*, Thomas Pynchon writes that a part of a schematic of a band-pass filter was the origin for the popular graffiti character, Kilroy.[4] [5]

References

[1] E. R. Kanasewich (1981). *Time Sequence Analysis in Geophysics* (http://books.google.com/books?id=k8SSLy-FYagC&pg=PA260&dq=band-pass-filter&lr=&as_brr=3&ei=7Y2uR4nCEoOssgPO7bD8BQ&sig=a3fmpt4zGisnq4vIt6Bi2urgb-U#PPA260,M1). University of Alberta. pp. 260. ISBN 0888640749. .

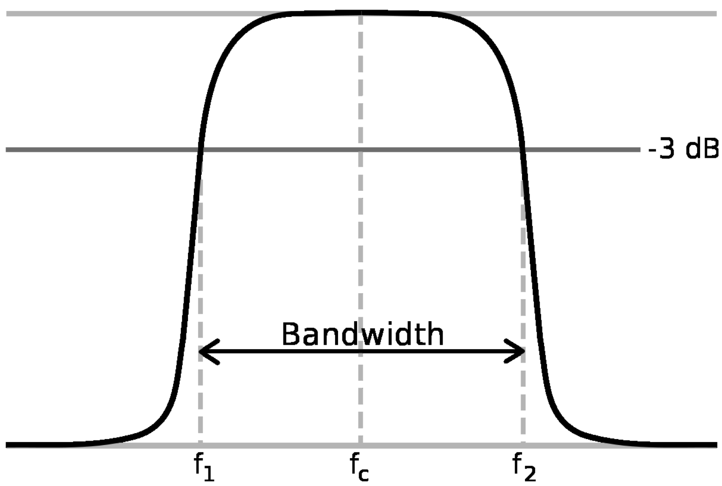
[2] Belle A. Shenoi (2006). *Introduction to digital signal processing and filter design* (http://books.google.com/books?id=37g8oUqaS_AC&pg=PA120&dq="bandpass+signal"&hl=en&ei=Qy3KTNvKN4nQsAOo46yHDg&sa=X&oi=book_result&ct=result&resnum=8&ved=0CE8Q6AEwBw#v=onepage&q="bandpass signal"&f=false). John Wiley and Sons. p. 120. ISBN 9780471464822. .

[3] Norman Stuart Sutherland (1979). *Tutorial Essays in Psychology* (http://books.google.com/books?id=yFbf_mulFuUC&pg=PA68&dq=bandpass-filter+Wiesel+Hubel&lr=&as_brr=3&ei=EJCuR8b1Ipm-swP7uKnyBQ&sig=0nmhJ6afsDuet2Eis-HA6wrPwdU#PPA68,M1). Lawrence Erlbaum Associates. pp. 68. ISBN 047026652X. .

[4] Thomas Pynchon (1999). *V.* (http://books.google.com/books?id=jqS2pmUIfOAC&pg=PA470&dq=band-pass-filter+kilroy&lr=&as_brr=3&ei=_IuuR_3ODaautgO77vj6BQ&sig=q2eTF8Sc0jNw4do4h6zaMyPuf0E). HarperCollins. pp. 470. ISBN 0060930217. .

[5] Samuel Thomas (2007). *Pynchon and the Political* (http://books.google.com/books?id=kw3eahkYar8C&pg=PA44&dq=band-pass-filter+kilroy+pynchon&lr=&as_brr=3&ei=TkdkScraLY_QkwT1-vH2Bw). Routledge. p. 44. ISBN 9780415956468. .

Cutoff frequency



Magnitude transfer function of a bandpass filter with lower 3dB cutoff frequency f_1 and upper 3dB cutoff frequency f_2

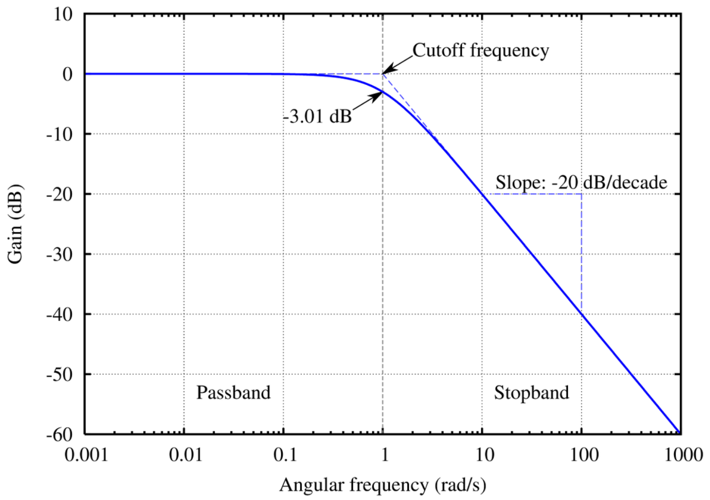
In physics and electrical engineering, a **cutoff frequency**, **corner frequency**, or **break frequency** is a boundary in a system's frequency response at which energy flowing through the system begins to be reduced (attenuated or reflected) rather than passing through.

Typically in electronic systems such as filters and communication channels, cutoff frequency applies to an edge in a lowpass, highpass, bandpass, or band-stop characteristic – a frequency characterizing a boundary between a passband and a stopband. It is sometimes taken to be the point in the filter response where a transition band and passband meet, for example as defined by a 3 dB corner, a frequency for which the output of the circuit is -3 dB of

the nominal passband value. Alternatively, a stopband corner frequency may be specified as a point where a transition band and a stopband meet: a frequency for which the attenuation is larger than the required stopband attenuation, which for example may be 30 dB or 100 dB.

In the case of a waveguide or an antenna, the cutoff frequencies correspond to the lower and upper **cutoff wavelengths**.

Cutoff frequency can also refer to the plasma frequency.



A bode plot of the Butterworth filter's frequency response, with corner frequency labeled. (The slope −20 dB per decade also equals −6 dB per octave.)

Electronics

In electronics, cutoff frequency or corner frequency is the frequency either above or below which the power output of a circuit, such as a line, amplifier, or electronic filter has fallen to a given proportion of the power in the passband. Most frequently this proportion is one half the passband power, also referred to as the 3dB point since a fall of 3dB corresponds approximately to half power. As a voltage ratio this is a fall to $\sqrt{1/2} \approx 0.707$of the passband voltage.[1]

However, other ratios are sometimes more convenient. For instance, in the case of the Chebyshev filter it is usual to define the cutoff frequency as the point after the last peak in the frequency response at which the level has fallen to the design value of the passband ripple. The amount of ripple in this class of filter can be set by the designer to any desired value, hence the ratio used could be any value.[2]

Communications

In communications, the term cutoff frequency can mean the frequency below which a radio wave fails to penetrate a layer of the ionosphere at the incidence angle required for transmission between two specified points by reflection from the layer.

Waveguides

The cutoff frequency of an electromagnetic waveguide is the lowest frequency for which a mode will propagate in it. In fiber optics, it is more common to consider the **cutoff wavelength**, the maximum wavelength that will propagate in an optical fiber or waveguide. The cutoff frequency is found with the characteristic equation of the Helmholtz equation for electromagnetic waves, which is derived from the electromagnetic wave equation by setting the longitudinal wave number equal to zero and solving for the frequency. Thus, any exciting frequency lower than the cutoff frequency will attenuate, rather than propagate. The following derivation assumes lossless walls. The value of c, the speed of light, should be taken to be the group velocity of light in whatever material fills the waveguide.

For a rectangular waveguide, the cutoff frequency is

$$\omega_c = c\sqrt{\left(\frac{n\pi}{a}\right)^2 + \left(\frac{m\pi}{b}\right)^2},$$

where $n, m \geq 0$ are the mode numbers and *a* and *b* the lengths of the sides of the rectangle.

The cutoff frequency of the TM_{01} mode in a waveguide of circular cross-section (the transverse-magnetic mode with no angular dependence and lowest radial dependence) is given by

$$\omega_c = c\frac{\chi_{01}}{r} = c\frac{2.4048}{r},$$

where r is the radius of the waveguide, and χ_{01} is the first root of $J_0(r)$, the bessel function of the first kind of order 1.

For a single-mode optical fiber, the cutoff wavelength is the wavelength at which the normalized frequency is approximately equal to 2.405.

Mathematical analysis

The starting point is the wave equation (which is derived from the Maxwell equations),

$$\left(\nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\right)\psi(\mathbf{r}, t) = 0,$$

which becomes a Helmholtz equation by considering only functions of the form

$$\psi(x, y, z, t) = \psi(x, y, z)e^{i\omega t}.$$

Substituting and evaluating the time derivative gives

$$(\nabla^2 + \frac{\omega^2}{c^2})\psi(x, y, z) = 0.$$

The function ψ here refers to whichever field (the electric field or the magnetic field) has no vector component in the longitudinal direction - the "transverse" field. It is a property of all the eigenmodes of the electromagnetic waveguide that at least one of the two fields is transverse. The *z* axis is defined to be along the axis of the waveguide.

The "longitudinal" derivative in the Laplacian can further be reduced by considering only functions of the form

$$\psi(x, y, z, t) = \psi(x, y)e^{i(\omega t - k_z z)},$$

where k_z is the longitudinal wavenumber, resulting in

$$(\nabla_T^2 - k_z^2 + \frac{\omega^2}{c^2})\psi(x, y, z) = 0,$$

where subscript T indicates a 2-dimensional transverse Laplacian. The final step depends on the geometry of the waveguide. The easiest geometry to solve is the rectangular waveguide. In that case the remainder of the Laplacian can be evaluated to its characteristic equation by considering solutions of the form

$$\psi(x, y, z, t) = \psi_0 e^{i(\omega t - k_z z - k_x x - k_y y)}.$$

Thus for the rectangular guide the Laplacian is evaluated, and we arrive at

$$\frac{\omega^2}{c^2} = k_x^2 + k_y^2 + k_z^2$$

The transverse wavenumbers can be specified from the standing wave boundary conditions for a rectangular geometry crossection with dimensions *a* and *b*:

$$k_x = \frac{n\pi}{a},$$

$$k_y = \frac{m\pi}{b},$$

where *n* and *m* are the two integers representing a specific eigenmode. Performing the final substitution, we obtain

$$\frac{\omega^2}{c^2} = \left(\frac{n\pi}{a}\right)^2 + \left(\frac{m\pi}{b}\right)^2 + k_z^2,$$

which is the dispersion relation in the rectangular waveguide. The cutoff frequency ω_c is the critical frequency between propagation and attenuation, which corresponds to the frequency at which the longitudinal wavenumber k_z is zero. It is given by

$$\omega_c = c\sqrt{\left(\frac{n\pi}{a}\right)^2 + \left(\frac{m\pi}{b}\right)^2}$$

The wave equations are also valid below the cutoff frequency, where the longitudinal wave number is imaginary. In this case, the field decays exponentially along the waveguide axis.

References

[1] Van Valkenburg, M. E.. *Network Analysis* (http://www.amazon.com/Network-Analysis-Mac-Van-Valkenburg/dp/0136110959) (3rd edition ed.). pp. 383–384. ISBN 0-13-611095-9. . Retrieved 2008-06-22.

[2] Mathaei, Young, Jones *Microwave Filters, Impedance-Matching Networks, and Coupling Structures*, pp.85-86, McGraw-Hill 1964.

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External links

- Calculation of the center frequency with geometric mean and comparison to the arithmetic mean solution (http://www.sengpielaudio.com/calculator-geommean.htm)
- Conversion of cutoff frequency f_c and time constant τ (http://www.sengpielaudio.com/calculator-timeconstant.htm)
- Mathematical definition of and information about the Bessel functions (http://mathworld.wolfram.com/BesselFunction.html)

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